
CELEBRATING 125 YEARS OF EXPLORATION
ANTARCTIC ADVENTURE
Australia's Big Bird
NGM.COM SEPTEMBER 2013
NATIONAL GEOGRAPHIC
HOW THEY ARE CHANGING OUR COASTLINES
RISING SEAS
JULY 11
NO ICE



West African Giraffe *(Giraffa camelopardalis peralta)*
Size: Head and body length (males), 381 - 550 cm (12.5 - 18 ft.); tail (males), 78.7 - 104.1 cm (2.6 - 3.4 ft.) **Weight:** 550 - 1,930 kg (1,212.5 - 4,254.9 lbs) **Habitat:** Southwestern Niger; prefers dry savannah and open woodland **Surviving number:** Estimated at 310

Photographed by Christophe Courteau

WILDLIFE AS CANON SEES IT

Looking up. After falling to a low of just 50 in 1996, the West African giraffe population is growing again, aided by conservation efforts and the absence of predators able to target the world's tallest terrestrial animal. Temporary groups forage at night, their long necks suited to reaching choice leaves. But to drink or feed on low vegetation, they are obliged to spread their front legs wide, and when fully asleep they curve their necks at extreme angles to rest their heads on a hip or upper rear leg while sitting. Room to stretch out is in short supply due to loss and fragmentation of habitat, and their comeback is far from certain.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit **canon.com/environment** to learn more.

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NATIONAL GEOGRAPHIC

"We tell our families we come for the money. But really, we come to escape."
page 86



PASCAL MAITRE

Red means force. White signifies purity. The traditional hues adorn members of the Bobongo Iyaya dance group, which has been performing in Kinshasa since 1987.

September 2013

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They're inevitable. And they're sure to be costly—especially if we don't prepare. Coastal cities are turning to the Netherlands for guidance.
By Tim Folger Photographs by George Steinmetz

Special Poster: If All the Ice Melted

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The cassowary is a standout: Six feet tall, 160-plus pounds, and dad sits on the eggs.
By Olivia Judson Photographs by Christian Ziegler

78 **Climbing Untamed Antarctica**
The first thing that the team members learned: Don't attach yourself to a kite.
By Freddie Wilkinson Photographs by Cory Richards

96 **Space Mountains**
Planets have them too. And they dwarf Everest.
By Luna Shyr

98 **JR: Prince of Prints**
From Cuba to Kenya, the bold artist makes political points with his giant portraits.
By Melody Kramer Photograph by Marco Grob

100 **Urban Pulse of the Congo**
The miracle of Kinshasa is that amid the chaos of this capital city, artists survive and thrive.
By Robert Draper Photographs by Pascal Maitre

124 **Failure Is an Option**
History shows that without it, we'd be nowhere.
By Hannah Bloch

September 2013

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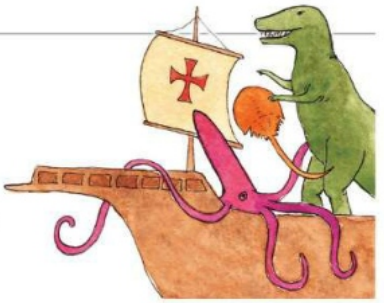


16 **Your Shot**

21 **NEXT**

A Swing and a Splinter
Baseballers like maple bats. One problem: They break more often than ash.

Quiz: Women Explorers
Who was first to go around the Earth? What did Sue Hendrickson discover?



Fairy Circles
They're grassy rings in southern Africa's deserts. Now we know their origin.

A Wave of Creativity
Washed-up toys and floats and nets are turned into art.

Pity the Pangolin
The mammal with up to a thousand scales is heavily trafficked for meat and medicine.



134 **NG Connect**
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Flashback

On the Cover If all of Earth's ice does melt thousands of years from now—the most extreme of all extreme scenarios—scientists estimate that the seas could rise up to 216 feet, covering much of Lady Liberty.
Art by Nick Kaloterakis

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Rising Seas
Animated Graphic
See how sea-level rise would reshape the planet.



Antarctic Climb
Video
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Kinshasa
Video
Watch a painter work by lantern light.

GRAPHIC: JASON TREAT, NGM STAFF
PHOTOS: CORY RICHARDS (TOP); PASCAL MAITRE

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A NEW PERSPECTIVE ON ADVENTURE VACATIONS





From left: Aerial view of Angkor Wat, Cambodia; tour bike parked outside a countryside Wat, Cambodia; giant cliffs and seashore in Pembrokeshire Coast National Park.

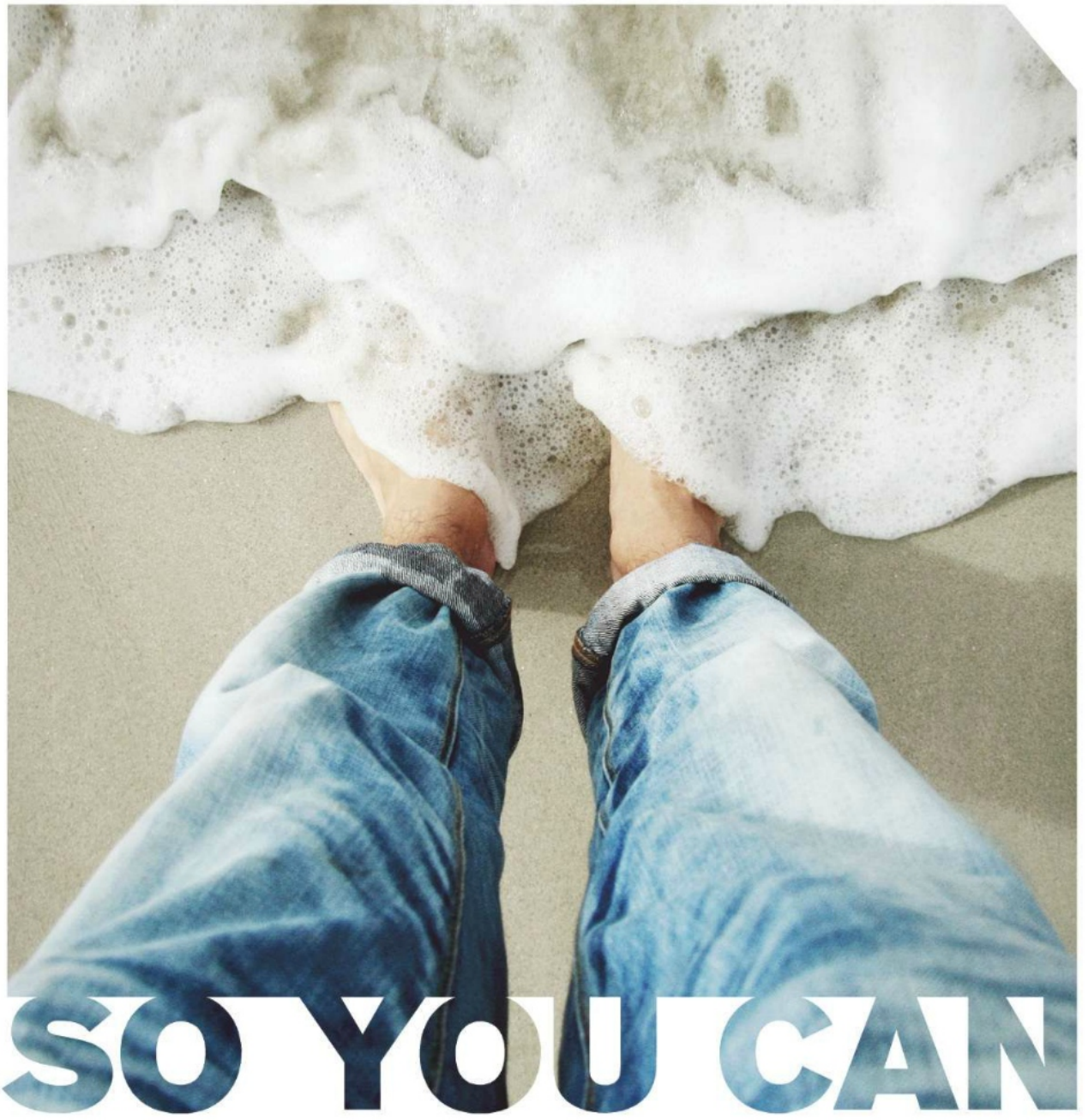
A vacation adventure becomes even more memorable when you approach your destination via the road less traveled—by bike, by foot, and, in the case of Pembrokeshire Coast National Park in Wales, cliff jumping. Take your trip to the next level by rewarding yourself with comfortable accommodations and long, leisurely dinners. But no matter where you go or how you get there, with **Chase** Sapphire *Preferred*® you get 2X points on travel and dining at restaurants.

BIKING CAMBODIA'S LOST CITY OF ANGKOR WAT

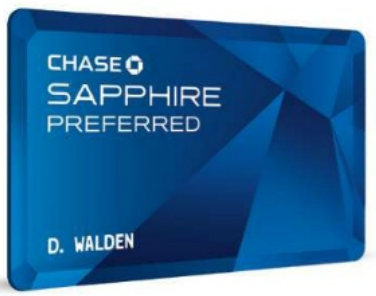
Southeast Asia's most awe-inspiring ancient temple complex—a UNESCO World Heritage site—takes on new dimension when a bicycle is part of the equation. Rent your wheels in the town of Siem Reap, and head out in the magical light of sunrise for the easy four-mile ride to the temple site. Cyclists get to choose from two biking circuits (one covers ten miles; the other, sixteen) that weave through jungle and forest, connecting the most outstanding among the complex's 1,000 temples. Amid all the historic architecture, the jewel in the crown is the site's namesake, Angkor Wat, built some 800 years ago and filled with larger-than-life moss-encrusted sculptures. This moated wonder, originally built as a Hindu temple dedicated to the god Vishnu, remains the largest religious archaeological site on the planet and is immortalized on Cambodia's flag. To provide a contemporary counterpoint to this back-in-time adventure, stay at one of the close-by luxury hotels and go shopping for locally crafted jewelry, baskets, textiles, and woven-silk shawls.

RISING TO THE CHALLENGE IN WALES

A well-kept secret beyond the British Isles, Pembrokeshire Coast National Park, on the west coast of Wales, is timelessly, exquisitely wild. The stunning landscape brims with sheer cliffs, caves, coves, and pristine waters. No other national park in the United Kingdom boasts so much coastline. But there is something new in the equation, an adventure sport with a 20th-century pedigree. Called coasteering, this adrenaline-rush pastime involves moving along rugged coastline at sea level. Helmets, wetsuits, and buoyancy aids help you navigate a thrilling mix of swimming, rock climbing, diving, riding waterfalls—whatever it takes to press on along the dramatic cliffs. And Wales is where this unique sport was born. Once back on land, enjoy wonderful locally sourced seafood at fine restaurants and hearty fare at cozy pubs. Remember, you get 2X points on travel and dining at restaurants with **Chase** Sapphire *Preferred*®. **Learn more at chasesapphire.com/preferred.**



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Sea Change

We are accustomed to hearing about catastrophes that change life in an instant—an earthquake, a fire, an explosion. But there is a catastrophe that is playing out in slow motion, measured out over the course of years, decades, and centuries. And it's happening now.

The culprit is not so much nature as ourselves. Our catastrophe has to do with dependence on fossil fuels, which has sparked a chain of events that has warmed the atmosphere and oceans and melted glaciers and continental ice sheets, and consequently raised sea levels.

A catastrophe is playing out in slow motion.

One estimate says that by 2070 the coastal flooding that will result from this rise may affect nearly 150 million people living in port cities. "We have irreversibly committed future generations to a hotter world and rising seas," says author Tim Folger in this month's cover story.

Because there are no computer models or scientists to tell us with certainty how fast and how much the seas will rise, it is a challenge to illustrate this story and telegraph the problem's urgency. You could say it requires a leap of faith in imagination that is grounded in fact. In telling this story—and others on the same subject that we have published—we have worked with the best scientists, illustrators, writers, photographers, and cartographers to bring clarity to complexity. We know the characters in this unfolding drama: the oceans, the vanishing glaciers and ice sheets, the ever more destructive storms, like last year's Sandy. It's just that we are trying to tell a story with an unwritten end.



ART: NICK KALOTERAKIS



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Clues to a Long Life

While filled with interesting anecdotes, the story of the search for life-extending genes is based on a naive technological optimism. It misses the profound question of how we can better meet the increasing challenges to public health around the world. Many of the basic tools that have extended average life spans are seriously at risk. The director-general of the World Health Organization, Margaret Chan, warned that "a post-antibiotic era means, in effect, an end to modern medicine as we know it." These are the types of issues on which funding, research, and policy need to be focused.

KEN DAHLBERG
Kalamazoo, Michigan

The table of contents listing asks, "You want to live to 120? And stay healthy?" I want to live to 120, even if I don't stay healthy. Good health is better than illness and disability, of course, but illness and disability do not keep life from being worth living. Just ask Stephen Hawking—or ask any of the many ill and disabled people who are not geniuses or great achievers of any sort but who still enjoy life.

FELICIA NIMUE ACKERMAN
Providence, Rhode Island

Your article about science trying to extend the life of humans appalled me, as did your January article on space exploration. We live on a planet whose climate is changing due to our misuse of technology, and we have propagated our own species to the destruction of countless others. Yet scientists want to pursue ways to make us live longer and travel about the universe, spreading our mayhem.

LAURA WOOL
Ayer, Massachusetts

How long will cover baby work?

THOMAS L. PRICE
Purvis, Mississippi

Why would anyone choose to live to be 120 years old? Will you still be in control of your mental faculties, be able to maintain your own home, drive a car, go dancing, have sex? I am an 83-year-old member of a pioneer New Mexico ranch family. I raised a family of four and retired 22 years ago. I am grateful every day for my family and the health that my husband of 65 years and I enjoy. Thanks, but no thanks, for diapers and a nursing home.

JOANN M. YOUNG
Tyrone, New Mexico

Corrections

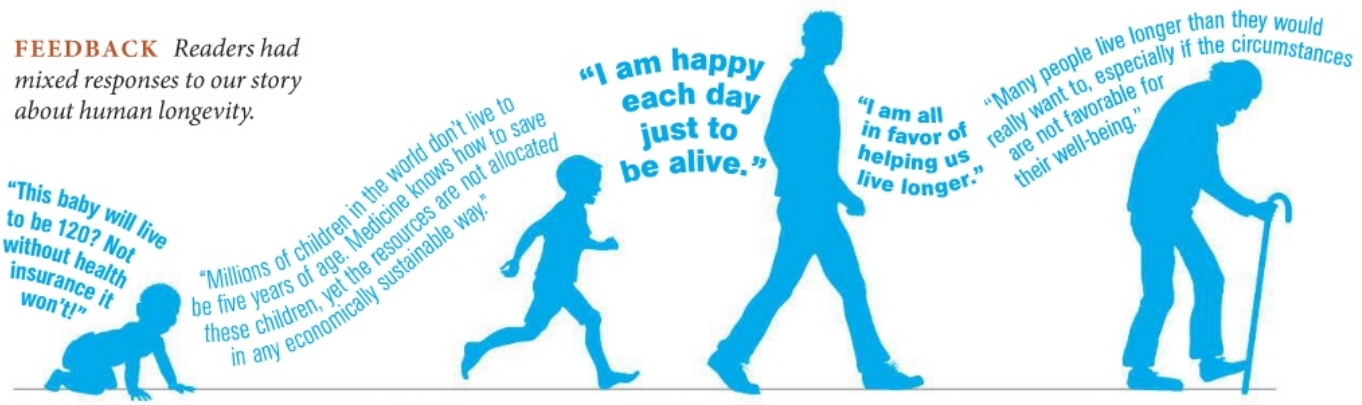
MAY 2013, NEXT: HOT ROLLERS The booties worn by the dung beetles during testing were made of silicone, not silicon.

ELEMENT HUNTERS In the graphic on page 119, the discovery of element 115 should have been attributed only to JINR Dubna/LLNL Livermore.

SUPER MATERIALS The diameter of the string of graphene on page 123 should have been one-tenth of a millimeter.

CHINA'S GRAND CANAL The middle character on page 132 was expressed in simplified Chinese rather than traditional Chinese.

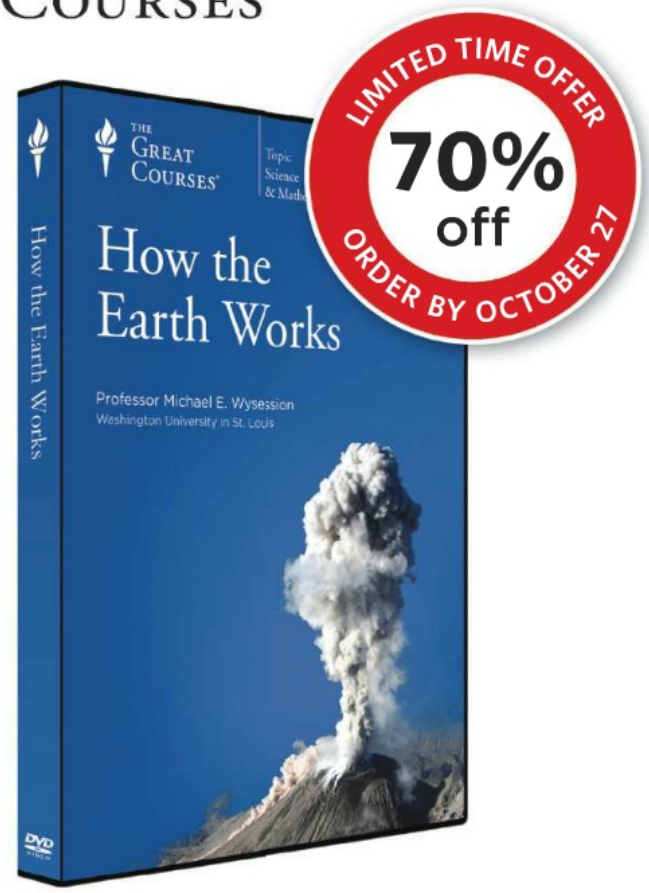
FEEDBACK *Readers had mixed responses to our story about human longevity.*



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GRAPHIC: MESA SCHUMACHER

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BOB PORTMESS
Ithaca, New York

As a boy some 60-odd years ago in central Kentucky, I remember that farmers would plant a fall cover crop to be plowed under, producing needed nutrients for the spring crops of corn and wheat. They would use crop rotation by planting corn one year, alfalfa the next, and so on. This was done for many years, until the family farm began to disappear and larger agribusinesses began to throw fertilizer at the ground in massive amounts. In my hometown there were no tanks of ammonia and nitrogen back then, but today there are silos, tanks, and storage bins full of fertilizers down at the local farm supply store. Sure, there are greater yields now, but you also don't see a farm pond that does not have a serious algae problem from all the runoff. Let's encourage the return to the hardworking and well-managed family farms and their concern for our planet.

ROD BRADSHAW
Danville, Kentucky

Wrangel Island

It was with great delight that I read this wonderful piece. It brought back a flood of memories and allowed my family a glimpse of an untraveled world that few ever see. Having spent a little time in the area courtesy of the U.S. Coast Guard during the period of 1961 to 1964, I had one reservation: The text says the Russians introduced muskoxen in 1975. I distinctly remember viewing muskoxen on the island slopes using a long glass. At least that's what we thought they were, being little more than moving black dots.

GERALD F. GAGNON
Lake Zurich, Illinois

I hear hope in the words of the victims. At great risk, brave people are breaking the silence.

Muskoxen died out completely about 2,000 years ago on Wrangel Island, says zoologist Ross MacPhee. He suggests that what you saw through your glass were reindeer.

The 20 muskoxen introduced to Wrangel Island came from Nunivak Island, Alaska. The United States and Russia agreed to the transfer during a period of rapprochement in 1975. A group of sportsmen in Fairbanks sued the Alaska Department of Fish and Game seeking to prevent the transfer. I was the judge. After three days of testimony I declined to interfere with the transfer. Now Wrangel Island is a nature sanctuary with more than 800 muskoxen.

JAMES R. BLAIR
Parachute, Colorado

Zimbabwe

I spent five months in Zimbabwe in a mission village called Loreto (not far from Gweru) in the fall of 1998. I was a novice in religious formation getting my first teaching experience. Nothing in my life before or since has had a greater impact on my worldview. I have long believed Robert Mugabe is among the worst world leaders. But I also want to believe that it's not as bad there as you say. Either way, I know the people in Zimbabwe deserve better.

SCOTT LOSAVIO
Baton Rouge, Louisiana

Running the contentious article "Breaking the Silence" is commendable. The fearless text tells of how the 33-year corrupt and bloody reign of the despot Robert Mugabe has ruined the economy and robbed farmers who fed the nation, while the stunning photographs tell the story of murder, misery, poverty, and hunger. But I hear hope in the words of the victims. At great risk, brave people are breaking the silence. They want the world to hear the truth. This well-told but sad story will reach your millions of readers, many of whom did not know the truth behind the disaster that is now Zimbabwe. I was born in Africa. I hope the world is listening.

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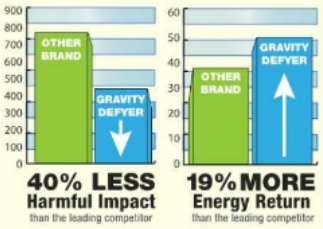
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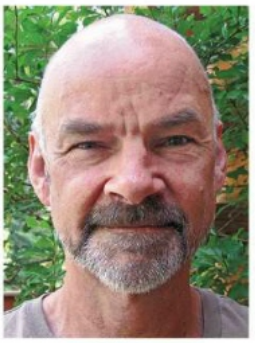
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Trevor Price
National Geographic Grantee

EXPERTISE
Ornithologist

LOCATION
Kashmir

Held Captive

My team was studying the bird species of the Himalaya when ten people with machine guns entered our camp and said, "You're coming with us." We usually work 11,000 feet up in the mountains, but we had dropped down to monitor the birds living at the lower elevations. At 8,000 feet there's a road. If we'd been higher up, they wouldn't have found us.

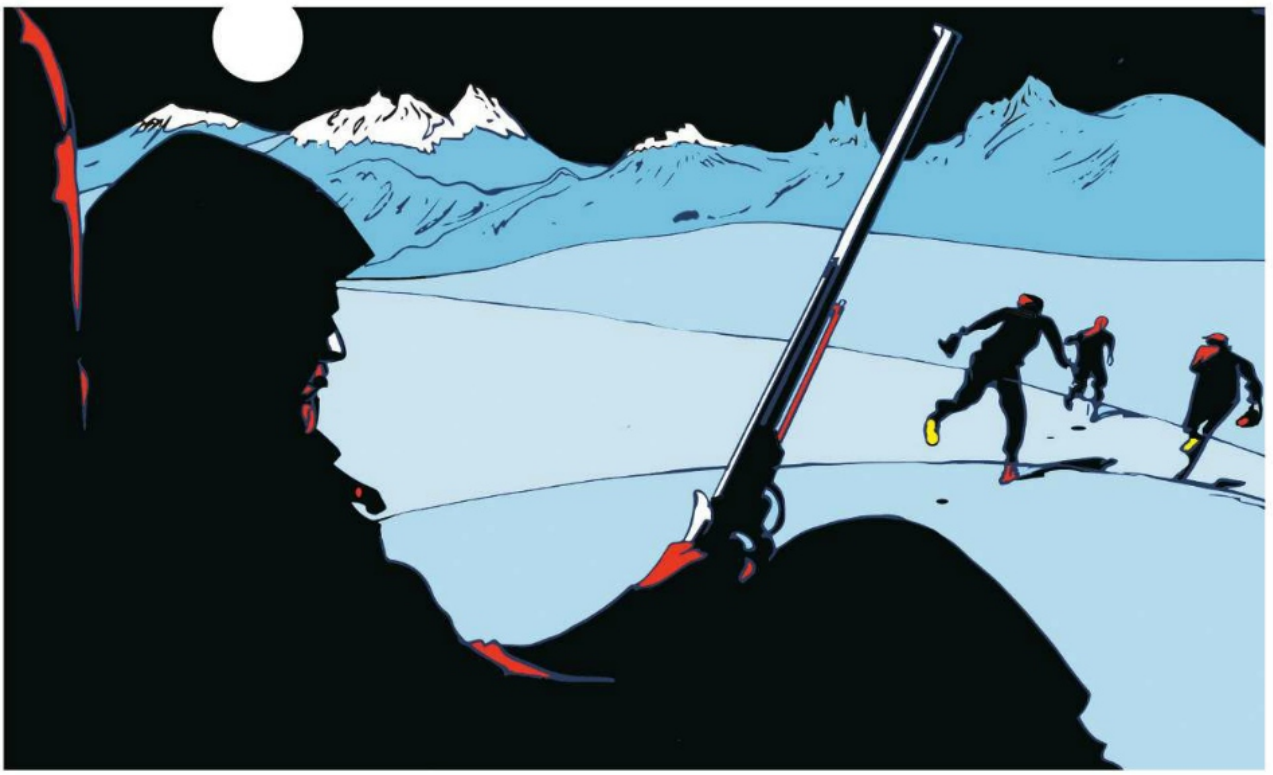
The Indian Army was everywhere—it was the early '90s and the region was in the middle of an insurgency. Our captors were Kashmiri rebels. They marched us toward the nearest village and put us on a small bus.

To keep covert, our captors kept changing our transport. They pistol-whipped a rickshaw driver for not giving up his vehicle quickly enough, took us about 15 miles, then commandeered another bus. Then they forced us to hike.

We stopped at a pasture that looked like a rebel outpost from a movie. The rebels wanted Amnesty International to come to Kashmir to document atrocities they claimed the Indian Army had committed. We—an Englishman and two Americans—were the bait.

Our captors were nice to us. They let us stay together. They would clean the seats for us to sit on while balancing AK-47s in their other hands. They challenged us to a tug-of-war, using an AK-47 as the line we shouldn't cross. We very judiciously lost.

On the fifth night one of our team noticed there was no guard at the door. In stocking feet, boots in our hands, we raced up the hill. We ran until dawn, passing surprised shepherds. When we finally found a road, we took all our money—only 500 rupees—and got on a passing bus to start on our journey back home.



ART: ISTVAN BANYAI. PHOTO: BETTINA HARR



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VISIONS



United States
Wedges of an orange generate enough current and electrical juice—3.5 volts—to power an LED. The fruit's citric acid helps electrons flow from galvanized nails to copper wire in this 14-hour exposure.

PHOTO: CALEB CHARLAND





Japan
Magma bombs explode, forked lightning flashes, and ash clouds billow as the 3,665-foot-tall Sakurajima volcano erupts in Kyushu. Dried lava flows from a massive blast in 1914 connect the former island to the Osumi Peninsula.

PHOTO: MARTIN RIETZE





Taiwan
Drawn to the sulfuric fire of a hand-lit acetylene torch, mackerel leap en masse into the nets of a boat near New Taipei City. A few elderly fishermen—working at night from May to September—are the last practitioners of this fishing technique.

PHOTO: CHANG MING CHIH

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This page features two photographs: one chosen by our editors and one chosen by our readers via online voting. For more information, go to *yourshot.nationalgeographic.com*.



EDITORS' CHOICE **Alexei Aliyev** Nizhniy Tagil, Russia

When Alexei Aliyev's family came back from a neighbor's birthday party, they discovered that a turkey had escaped from their farm. After his mother went to retrieve it, Aliyev stopped her so he could take a photo in front of their house. "Photograph quickly," she told him. "He is very heavy!"



READERS' CHOICE

Jeff Rose
Batesville, Arkansas

On his way to photograph waterfalls on the Ozark Plateau, Rose passed a pair of male elk—one young, one older—sharing a quiet moment, a rarity among males that often spar with each other. Immediately after Rose took this photo, the bull stood and walked off.



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Best in Show

Nearly 22,000 images were submitted to the 2012 annual National Geographic Photo Contest, representing more than 150 countries. Our judges selected images by Ashley Vincent, Nenad Saljic, and Micah Albert as winners in the categories of Nature, Places, and People. The grand-prize winner received $10,000 and an invitation to visit the National Geographic headquarters in Washington, D.C.

For more information, go to *ngphotocontest.com.*

NATURE AND GRAND-PRIZE WINNER
Ashley Vincent
Bang Lamung, Thailand

Vincent had shot hundreds of photos of a tigress at Thailand's Khao Kheow Open Zoo. The way the cat dried off after a dip offered a dazzling new angle.

PLACES
Nenad Saljic
Split, Croatia

Vacationing in Switzerland near the Matterhorn, Saljic awoke one day at 3 a.m. feeling that something might be happening. "It was magic," he says.

PEOPLE
Micah Albert
Fair Oaks, California

At the overfilled Dandora dump in Nairobi, Kenya, Albert wanted to document the health hazards to the community and to the people paid to sort trash.

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CELEBRATING 125 YEARS **A NEW AGE OF EXPLORATION**

PHOTO: RAMESH RATWATTE

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NEXT



Slugger's Dilemma

Major leaguers broke 1,697 baseball bats between July and September 2012. It's not surprising, given what the skinny piece of wood has to withstand. When a 90-plus-mile-an-hour pitch makes contact, it exerts about 8,000 pounds of force, and vibrations ripple across the bat. If the ball hits a weak spot, the wood may break. Ash generally holds up. Today, though, more players, many out of superstition or bat feel, prefer maple bats, which constitute 64 percent of all sales.

But maple's grain—shaped into a bat—can make the wood weaker. Scientists are studying broken major league bats to improve maple bats' stamina and develop regulations to avoid multiple-piece breaks to prevent injury. Inside pitches are the culprit about two-thirds of the time, catching the bat at its thinnest. "If batters could always hit in the sweet spot," says Patrick Drane, assistant director of the Baseball Research Center at the University of Massachusetts Lowell, "you'd pretty much not have broken bats ever." *—Johnna Rizzo*

PHOTO: MARK THIESSEN, NGM STAFF. BATS COURTESY DAVID KRETSCHMANN, USDA FOREST SERVICE

Genius Unleashed

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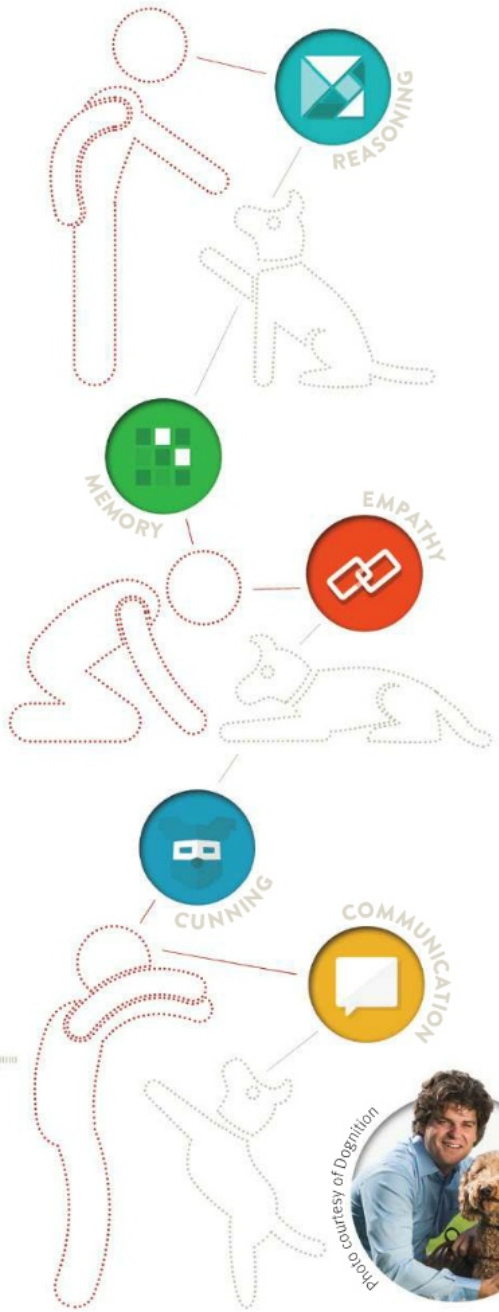
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NATIONAL GEOGRAPHIC creative STUDIO

The "aha" moment happened 15 years ago in his parents' garage. "My academic advisor said that humans have a unique ability that allows them to develop a culture and language—he was talking about communicating by gestures," says Dr. Brian Hare, founder of the Duke Canine Cognition Center. "I said, 'I think my dog can do that!'"



Hare played some basic games with his childhood dog, Oreo, that tested his intrinsic instincts. When he pointed in different directions to help Oreo retrieve toys or locate hidden food, his dog would respond to his gestures every time.

From these basic experiments, a revolution in dog cognitive science was born. The genius of dogs is that "they use humans like computers, to solve problems," says Dr. Hare. Later experiments proved that the dog's ancestor, the wolf, and even primates, do not similarly follow human cues. In partnership with Purina ONE and other supporters, Dr. Hare recently co-founded Dognition, a service that enables all dog lovers to get a fresh perspective on how their dog sees the world—while also contributing to the largest research database ever produced on the dog mind, enabling a better understanding of all dogs.

Dognition assesses your dog's forms of intelligence through a series of simple and eye-opening games. These exercises reveal dogs' cognitive profile in five areas: empathy, communication, memory, cunning, and reasoning. For example, one test involves putting food under one of two cups in full view of the dog, then pointing to the empty cup. If your dog follows your gesture, his typical problem-solving strategy is through communication; if he chooses the other, he relies on memory. Another test helps determine empathy: When you yawn, does your dog follow suit? Comparing your dog's mindset with all other dogs in the assessment reveals your dog's unique genius.

Participants input results and receive a custom report that assesses their dogs' cognitive profile, including Renaissance Dog, Charmer, and Ace. At Dognition.com owners can get the first two dimensions at no cost or purchase a complete Dognition Assessment Toolkit. "In the three months since Dognition launched, we've measured more dogs than I've been able to do in ten years" at his lab, says Dr. Hare.

He points out that dog intelligence isn't a number, like an IQ. "The question isn't whether your dog is smart or not," he says, "but rather, what are the skills your dog is using to be so successful?" Dr. Hare measures canines' "success" in terms of charming humans to give them complete care: "You love, feed, and clean up after your dog!"

Purina ONE's involvement with Dognition is a natural extension of its mission to leverage scientific innovations to help owners provide the best possible care for their dogs. "Dognition and Purina ONE have the same goal, which is to enhance the lives of dogs," says Dr. Hare. "Purina ONE focuses on what goes inside and we focus on the mind of the dog and helping people understand what makes their dog an individual."

As in humans, there's a mind-body connection that may benefit from canine cognition research. "What's exciting about Purina ONE is that they're engaged in cutting-edge science" that may continue to reveal dietary formulas that can help enhance canine cognitive performance. It's an "aha" moment that may soon be at hand, thanks to Dognition and the help of dog lovers around the world.

Photo courtesy of Dognition

Dognition™

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DR. BRIAN HARE is associate professor of evolutionary anthropology at Duke University and founder of the Duke Canine Cognition Center. With his wife, researcher Vanessa Woods, Dr. Hare authored *The New York Times* bestseller, "The Genius of Dogs," and co-founded Dognition.

EXPLORE

This quiz is the fifth of seven to run in 2013 to celebrate National Geographic's 125th anniversary. The next quiz will appear in October.

WOMEN AND DISCOVERY

For centuries female explorers got to pursue their ambitions only in disguise or against fierce resistance. If they somehow succeeded, society often ignored them or, worse, treated them as superwomen, because that was a way, Egyptian feminist Huda Shaarawi wrote, "to avoid recognizing the capabilities of all women." With that in mind, this quiz celebrates ordinary women doing extraordinary things.

1. WHO WAS THE **FIRST WOMAN** TO CIRCUMNAVIGATE THE EARTH? A. Krystyna Chojnowska-Liskiewicz B. Naomi James C. Tania Aebi D. Jeanne Baret

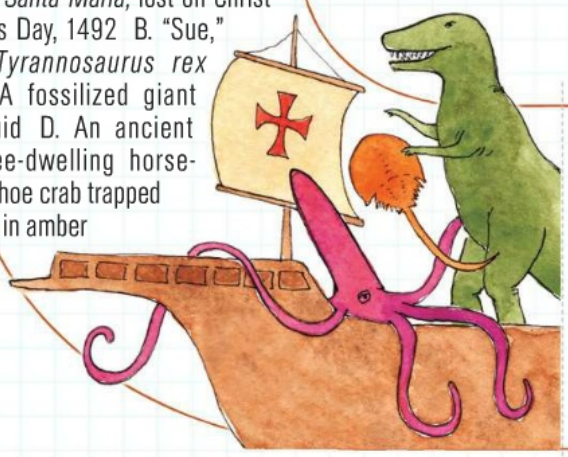
2. IN 1910 A CIGARETTE COMPANY FEATURED **MISS ANNIE SMITH PECK** ON ITS TRADING CARD SERIES OF "THE WORLD'S GREATEST EXPLORERS." WHO WAS SHE? A. The first person to bring back a living electric eel from South America B. A solo traveler down the length of the Amazon C. A pioneering mountain climber D. A biologist tracking jaguars solo at night



3. MISSY MAZZOLI'S 2012 OPERA ***SONG FROM THE UPROAR*** IS BASED ON THE LIFE OF WHICH **FEMALE EXPLORER IN AFRICA?** A. Isabelle Eberhardt B. Mary Kingsley C. Mary Leakey D. Delia Akeley



4. WHICH IS THE BEST KNOWN AMONG THE FOSSILS, SHIPWRECKS, AND ARTIFACTS **SUE HENDRICKSON** HAS DISCOVERED AROUND THE WORLD? A. The keel of the *Santa María,* lost on Christmas Day, 1492 B. "Sue," a *Tyrannosaurus rex* C. A fossilized giant squid D. An ancient tree-dwelling horseshoe crab trapped in amber



5. THE *NEW YORK TIMES* NAMED HER **ONE OF THE LEADING WOMEN EXPLORERS IN THE WORLD.** WHO WAS SHE? A. Annie Edson Taylor B. Harriet Chalmers Adams C. Nellie Bly D. Amelia Earhart

6. AFTER RETIRING FROM HER **NURSING CAREER** SOME YEARS AGO, **BARBARA HILLARY** DECIDED TO TRAVEL. AT THE AGE OF 79 SHE BECAME **THE FIRST BLACK WOMAN** TO DO WHAT? A. Dive to the *Titanic* B. Visit both the North and South Poles C. Summit Everest D. Swim the English Channel

FIND ANSWERS ON PAGE 29.

HANNAH TAK, NGM STAFF. ART: MARC JOHNS; AMERICAN TOBACCO (PECK CARD); NGM ART (MASK). NGM MAPS

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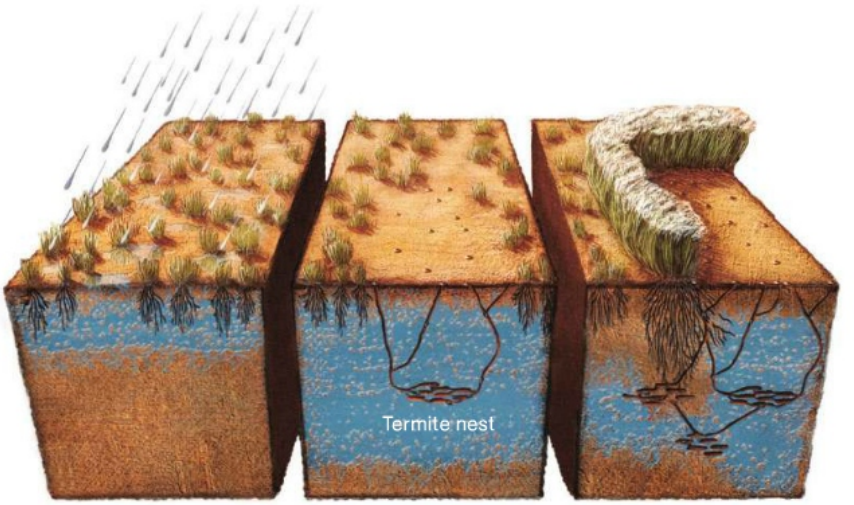
There are 52 bones in the feet—about 25 percent of a human body's total.



Desert Rings

Thousands of fairy circles dot southern Africa's deserts. Cultural lore has long attributed the grassy loops to supernatural causes. New research points to a more earthly source. Ecologist Norbert Juergens found *Psammotermes allocerus*, a termite species that lives in sand, under almost all of the nearly 2,000 circles he visited. "The termites are damaging the roots of the grasses that germinate in the bare patch," says Juergens.

The termite-engineered ecosystem comes with benefits. A lack of plants above the nest means the soil retains more water for the insects to consume. A circle forms when nearby grasses tap into the new reservoir and grow thicker, up to three feet tall. The combination of soil moisture and durable grass can bring additional life to a barren area, providing a haven for ants, bees, and even some mammals. *—Daniel Stone*



1 Heavy rains that fall between January and March help small patches of grass grow quickly in the desert landscape.

2 Termites eat any grass roots above their nest, leaving a barren circle. With no vegetation, rain collects in the porous soil below.

3 Extra groundwater allows the outside ring of grass to grow taller. Termites eat deeper roots sparingly to sustain the food source.



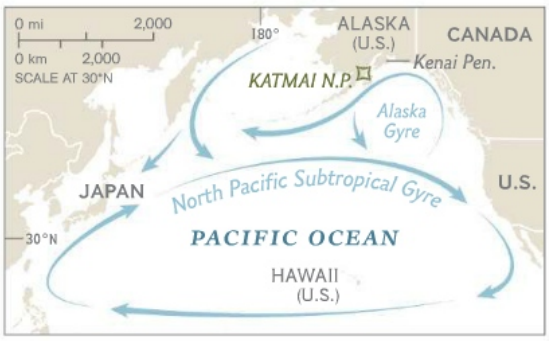
PHOTO: GEORGE STEINMETZ. GRAPHIC: ÁLVARO VALIÑO. ART: MESA SCHUMACHER
SOURCE: NORBERT JUERGENS, UNIVERSITY OF HAMBURG



Current Work

Pam Longobardi is an artist—and a trash collector. Pieces of carefully tagged plastic debris she's picked up from coasts around the world fill her Atlanta, Georgia, studio. Many of the seaworn toys, tangled nets, and fishing floats were spewed onto beaches from Hawaii to California by currents of the North Pacific Gyre, and thousands of the pieces will find their way into her art.

Now Longobardi has more to work with. She was part of a team of scientists and artists on the 2013 Gyre Expedition. The group traveled to Alaska's Kenai Peninsula and Katmai National Park to collect and source gyre-carried trash. A traveling exhibit of scientific findings and art made from the debris is planned for 2014. *—Margaret G. Zackowitz*



The North Pacific Gyre is a system of currents that swirl in a massive circuit, picking up debris from one coast and depositing it on shores elsewhere.

Learn more and see videos from the 2013 Gyre Expedition at nationalgeographic.com/gyre.

PHOTOS: REBECCA HALE, NGM STAFF. COLLECTION OF PAM LONGOBARDI. NGM MAPS

How to Outsmart a Millionaire

Only the "Robin Hood of Watchmakers" can steal the spotlight from a luxury legend for under $200!



Mr. Bigshot rolled up in a roaring high-performance Italian sports car, dropping attitude like his $14,000 watch made it okay for him to be rude. That's when I decided to roll up my sleeves and teach him a lesson.

"Nice watch," I said, pointing to his and holding up mine. He nodded like we belonged to the same club. We did, but he literally paid 100 times more for his membership. Bigshot bragged about his five-figure purchase, a luxury heavyweight from the titan of high-priced timepieces. I told him that mine was the ***Stauer Corso, a 27-jewel automatic classic now available for only $179.*** And just like that, the man was at a loss for words.

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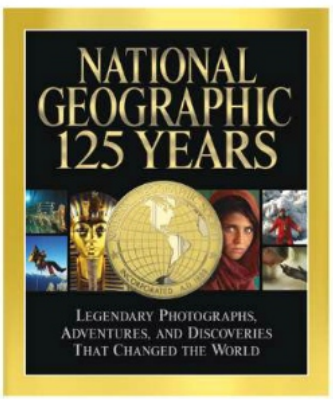


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The world's smallest known vertebrate is the *Paedophryne amauensis* frog of New Guinea.



Actual size



Pangolin's Peril

The pangolin is in trouble. Tens of thousands have been traded illegally across Asia since 2000, according to estimates. It's a trade that ranks them as one of the most trafficked mammals in Southeast Asia, above even rhinos and elephants. Single seizures in Indonesia and Vietnam have counted 15 metric tons of the house cat–size creatures, part of a massive harvesting for meat and medicine that has resulted in their disappearance from sections of their range, says Chris Shepherd of wildlife trade monitoring group Traffic. Now the trade is invading sub-Saharan Africa, the pangolin's other home. —*Christopher Solomon*

Asian and African (above) pangolins are armored with up to a thousand scales—sold to treat ailments from low lactation to cancer.

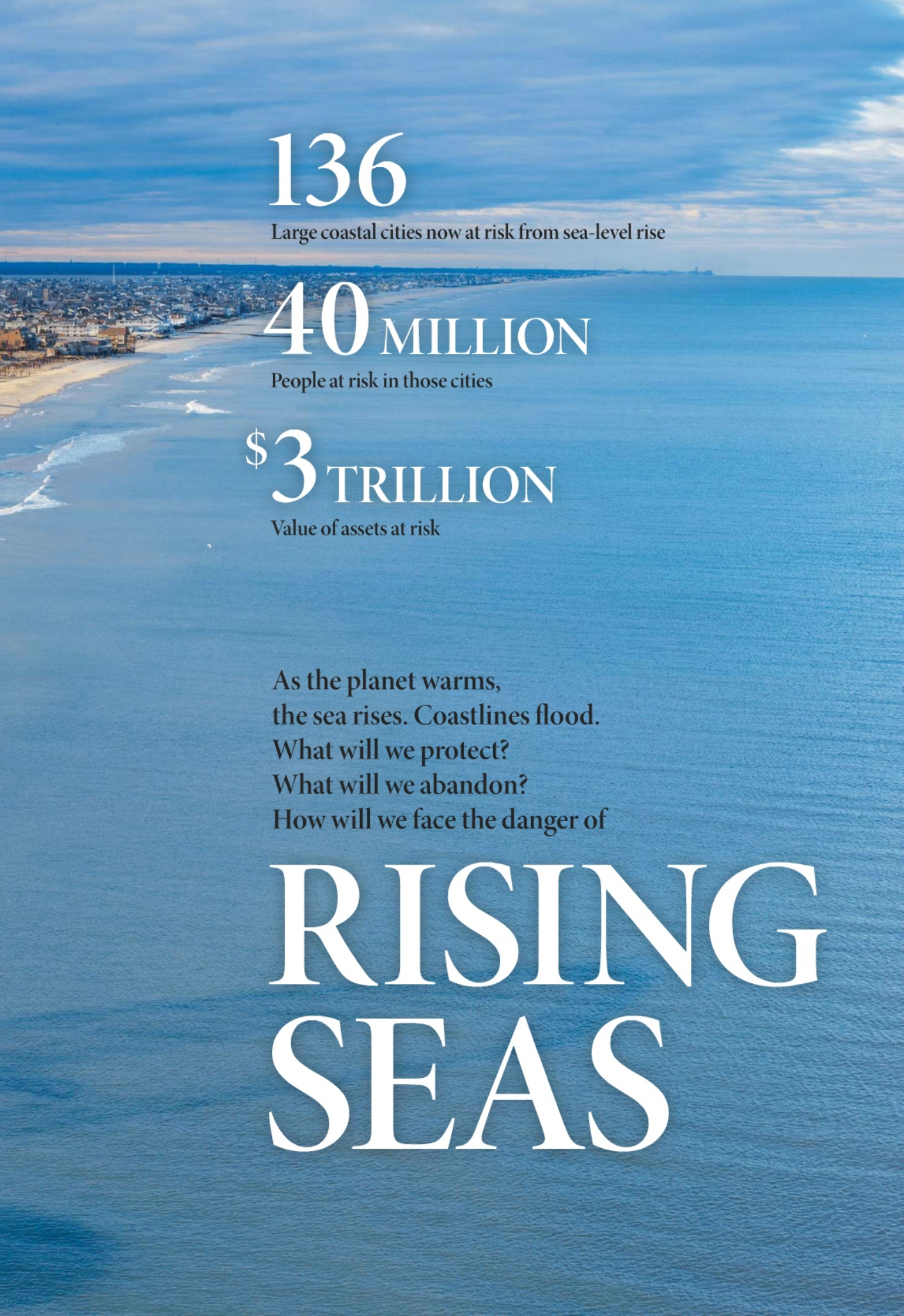
ANSWERS FOR EXPLORERS QUIZ

1. (D) Jeanne Baret. When French botanist Philibert Commerson joined Louis-Antoine de Bougainville's 1766-1769 expedition around the world, Baret disguised herself as a man and signed on as Commerson's valet. She was evidently both his lover and an expert botanist, and she did much of the work of collecting plants, probably including the flowering vine now known as bougainvillea.
2. (C) A pioneering mountain climber. Born to a prominent Rhode Island family, Peck discovered her love for climbing at the age of 44. She went on to make many difficult climbs in South America and elsewhere. She once planted a suffragist's flag saying "Votes for Women" at the top of Mount Coropuna in Peru.
3. (A) Isabelle Eberhardt. A Swiss-born convert to Islam, Eberhardt traveled in northern Algeria dressed as a man. Calling herself Si Mahmoud Essadi, she joined a Sufi order, the Qadiriyya, which focused on spiritual well-being for Muslims. She documented her travels in articles and books before drowning in a flood. Her life inspired the opera *Song From the Uproar* and a 1991 film.
4. (B) "Sue," a *Tyrannosaurus rex.* Self-taught explorer Sue Hendrickson specializes in fossils trapped in amber and marine archaeology. But in 1990, while searching in the Black Hills of South Dakota, she and her golden retriever found what turned out to be the largest known specimen of *T. rex.* "Sue," as the find was named in Hendrickson's honor, is now on display at the Field Museum, in Chicago, Illinois.
5. (B) Harriet Chalmers Adams. Between 1907 and 1935, Adams contributed 21 articles to *National Geographic* magazine. Traveling mainly through South America, often on horseback, Adams was bitten by vampire bats and suffered a broken back. But she also declared that she had "never faced a difficulty which a woman, as well as a man, could not surmount." She helped form the Society of Women Geographers in 1925.
6. (B) Visit both the North and South Poles. Having survived breast and lung cancer, Hillary fell in love with the far north after taking a dogsledding trip in the Arctic. Then she learned that a black woman had never been to the North Pole. "Wouldn't it be better to die doing something interesting," she said, "than to drop dead in an office and the last thing you see is someone you don't like?" She made it to the North Pole in 2007 and the South Pole in 2011.

PHOTO: NIGEL DENNIS. GRAPHIC: MESA SCHUMACHER



Superstorm Sandy narrowed New Jersey's beaches by more than 30 feet on average. At Seaside Heights it swept away the pier under the roller coaster.



136

Large coastal cities now at risk from sea-level rise

40 MILLION

People at risk in those cities

$3 TRILLION

Value of assets at risk

As the planet warms,
the sea rises. Coastlines flood.
What will we protect?
What will we abandon?
How will we face the danger of

RISING SEAS



14 FEET

Height of Sandy's surge at Battery Park

43

Deaths in New



In Manhattan, Sandy's surging tide knocked out a Con Ed substation, darkening the city below Midtown. Private generators provided some light, including the blue glow of the new World Trade Center, whose base is three feet above sea level.

York City

$19 BILLION

Damages in the city

IWAN BAAN, REPORTAGE BY GETTY IMAGES



THE DAMAGE DONE

By the time Sandy struck the Northeast, as a NASA computer model (above) had predicted four days earlier, it had killed 72 people in the Caribbean. It was no longer a hurricane—but it was a thousand miles wide, with 80-mile-an-hour winds that drove the sea onto the coast in lethal surges. The final death toll was 147. As the world warms, it may see more storms like Sandy. It will certainly see higher seas.



BROOKLYN, NEW YORK



PATH STATION



BREEZY POINT, QUEENS, NEW YORK



UNION BEACH



HOBOKEN, NEW JERSEY



MANTOLOKIN



SABANA PERDIDA, DOMINICAN REPUBLIC



LONG BEACH

LEFT: WILLIAM PUTNAM, NASA GODDARD SPACE FLIGHT CENTER. ABOVE (FROM TOP, LEFT TO RIGHT): KIRSTEN LU AFP PHOTO; JB NICHOLAS, SPLASH NEWS/CORBIS; KEN CEDENO, CORBIS; CHARLES SYKES, AP IMAGES; GEORGE



HOBOKEN, NEW JERSEY



RODANTHE, NORTH CAROLINA



STATEN ISLAND, NEW YORK



NEW JERSEY



ROCKAWAY PARK, QUEENS, NEW YORK



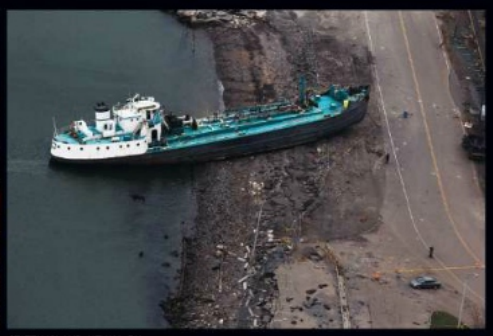
, NEW JERSEY



NEW YORK



STATEN ISLAND, NEW YORK



STATEN ISLAND, NEW YORK

E, NEW YORK TIMES/REDUX; PORT AUTHORITY OF NEW YORK & NEW JERSEY,
TEINMETZ; RICARDO ROJAS, REUTERS; ANDREW BURTON, GETTY IMAGES

ABOVE (FROM TOP, LEFT TO RIGHT): STEVE EARLEY, *VIRGINIAN-PILOT*; MICHAEL KIRBY SMITH, NEW YORK TIMES/REDUX; KEN CEDENO, CORBIS; CHANG W. LEE, NEW YORK TIMES/REDUX;
JOHN MINCHILLO, AP IMAGES

BY TIM FOLGER
PHOTOGRAPHS BY GEORGE STEINMETZ



An orange line sprayed on this condemned house—and on Robb Braidwood of the Chesapeake, Virginia, Office of Emergency Management—marks the typical flood height in the neighborhood. "It doesn't take a major storm," says Braidwood. "Heavy rain and the right wind during a high tide will do it."

MARK THIESSEN, NGM STAFF



BY THE TIME HURRICANE SANDY VEERED TOWARD THE NORTHEAST

coast of the United States last October 29, it had mauled several countries in the Caribbean and left dozens dead. Faced with the largest storm ever spawned over the Atlantic, New York and other cities ordered mandatory evacuations of low-lying areas. Not everyone complied. Those who chose to ride out Sandy got a preview of the future, in which a warmer world will lead to inexorably rising seas.

Brandon d'Leo, a 43-year-old sculptor and surfer, lives on the Rockaway Peninsula, a narrow, densely populated, 11-mile-long sandy strip that juts from the western end of Long Island. Like many of his neighbors, d'Leo had remained at home through Hurricane Irene the year before. "When they told us the tidal surge from this storm would be worse, I wasn't afraid," he says. That would soon change.

D'Leo rents a second-floor apartment in a three-story house across the street from the beach on the peninsula's southern shore. At about 3:30 in the afternoon he went outside. Waves were crashing against the five-and-a-half-mile-long boardwalk. "Water had already begun to breach the boardwalk," he says. "I thought, Wow, we still have four and a half hours until high tide. In ten minutes the water probably came ten feet closer to the street."

Back in his apartment, d'Leo and a neighbor, Davina Grincevicius, watched the sea as wind-driven rain pelted the sliding glass door of his living room. His landlord, fearing the house might flood, had shut off the electricity. As darkness fell, Grincevicius saw something alarming. "I think the boardwalk just moved," she said. Within minutes another surge of water lifted the boardwalk again. It began to snap apart.

Three large sections of the boardwalk smashed against two pine trees in front of d'Leo's apartment.

The street had become a four-foot-deep river, as wave after wave poured water onto the peninsula. Cars began to float in the churning water, their wailing alarms adding to the cacophony of wind, rushing water, and cracking wood. A bobbing red Mini Cooper, its headlights flashing, became wedged against one of the pine trees in the front yard. To the west the sky lit up with what looked like fireworks—electrical transformers were exploding in Breezy Point, a neighborhood near the tip of the peninsula. More than one hundred homes there burned to the ground that night.

The trees in the front yard saved d'Leo's house, and maybe the lives of everyone inside—d'Leo, Grincevicius, and two elderly women who lived in an apartment downstairs. "There was no option to get out," d'Leo says. "I have six surfboards in my apartment, and I was thinking, if anything comes through the wall, I'll try to get everyone on those boards and try to get up the block. But if we'd had to get in that water, it wouldn't have been good."

After a fitful night's sleep d'Leo went outside shortly before sunrise. The water had receded, but thigh-deep pools still filled parts of some streets. "Everything was covered with sand," he says. "It looked like another planet."

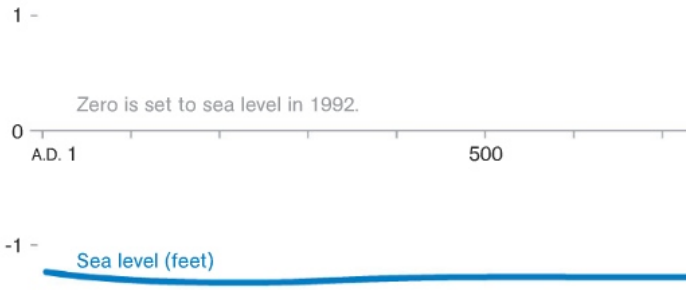
A PROFOUNDLY ALTERED PLANET is what our fossil-fuel-driven civilization is creating, a planet where Sandy-scale flooding will become more common and more destructive for the world's coastal cities. By releasing carbon dioxide and other heat-trapping gases into the atmosphere, we have warmed the Earth by more than a full degree Fahrenheit over the past century and raised sea level by about eight inches. Even if we stopped burning all fossil fuels tomorrow, the existing greenhouse gases would continue to warm the Earth for centuries. We have irreversibly committed future generations to a hotter world and rising seas.

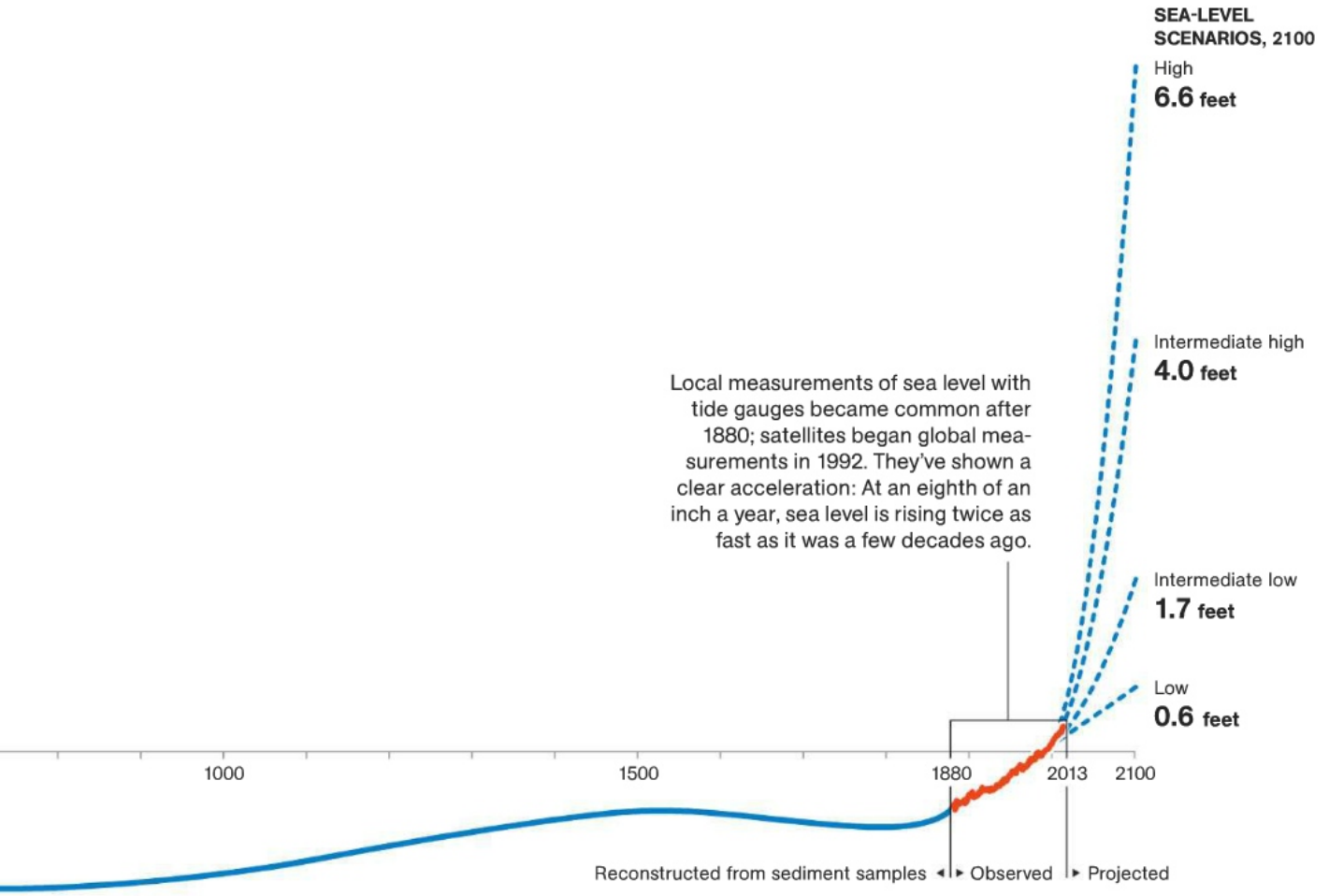
In May the concentration of carbon dioxide in the atmosphere reached 400 parts per million, the highest since three million years ago. Sea levels then may have been as much as 65 feet above today's; the Northern Hemisphere was largely ice free year-round. It would take centuries for the oceans to reach such catastrophic heights again, and much depends on whether we manage to limit future greenhouse gas emissions. In the short term scientists are still uncertain about how fast and how high seas will rise. Estimates have repeatedly been too conservative.

Global warming affects sea level in two ways. About a third of its current rise comes from thermal expansion—from the fact that water grows in volume as it warms. The rest comes from the melting of ice on land. So far it's been mostly mountain glaciers, but the big concern for the future is the giant ice sheets in Greenland and Antarctica. Six years ago the Intergovernmental Panel on Climate Change (IPCC) issued a report predicting a maximum of 23 inches of sea-level rise by the end of this century. But that report intentionally omitted the possibility that the ice sheets might flow more rapidly into the sea, on the grounds that the physics of that process was poorly understood.

Rising Seas

Sea level didn't change much for nearly 2,000 years, judging from sediment cores. It began to rise in the late 19th century, as Earth started to warm. If sea level continues to track temperature, it could rise three feet or more by 2100. The great unknown: the future of the ice sheets. NOAA's four scenarios, shown here, span the range of possibilities for 2100. The sea will keep rising after that.





As the IPCC prepares to issue a new report this fall, in which the sea-level forecast is expected to be slightly higher, gaps in ice-sheet science remain. But climate scientists now estimate that Greenland and Antarctica combined have lost on average about 50 cubic miles of ice each year since 1992—roughly 200 billion metric tons of ice annually. Many think sea level will be at least three feet higher than today by 2100. Even that figure might be too low.

"In the last several years we've observed accelerated melting of the ice sheets in Greenland and West Antarctica," says Radley Horton, a research scientist at Columbia University's Earth Institute in New York City. "The concern is that if the acceleration continues, by the time we get to the end of the 21st century, we could see sea-level rise of as much as six feet globally instead of two to three feet." Last year an expert panel convened by the National Oceanic and Atmospheric Administration adopted 6.6 feet (two meters) as its highest of four scenarios for 2100. The U.S. Army Corps of Engineers recommends that planners consider a high scenario of five feet.

One of the biggest wild cards in all sea-level-rise scenarios is the massive Thwaites Glacier in West Antarctica. Four years ago NASA sponsored a series of flights over the region that used ice-penetrating radar to map the seafloor topography. The flights revealed that a 2,000-foot-high undersea ridge holds the Thwaites Glacier in place, slowing its slide into the sea. A rising sea could allow more water to seep between ridge and glacier and eventually unmoor it. But no one knows when or if that will happen.

"That's one place I'm really nervous about," says Richard Alley, a glaciologist at Penn State University and an author of the last IPCC report. "It involves the physics of ice fracture that we really don't understand." If the Thwaites Glacier breaks free from its rocky berth, that would liberate enough ice to raise sea level by three meters—nearly ten feet. "The odds are in our favor that it won't put three meters in the ocean in the next century," says Alley. "But we can't absolutely guarantee that. There's at least some

LAWSON PARKER, NGM STAFF. SOURCES: JOSH WILLIS, NASA/JPL; JOHN CHURCH AND NEIL WHITE, COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION; ANDREW KEMP ET AL., 2011; R. STEVEN NEREM ET AL., 2010; NOAA

Contributors to Rising Sea Levels

Locally, sea level can rise because the land is sinking. Globally, it rises because the total volume of seawater is increasing. Global warming drives that in two basic ways: by warming the ocean and by melting ice on land, which adds more water. Since 1900 global sea level has risen about eight inches. It's now rising at about an eighth of an inch a year—and accelerating.



IA HUMMING GLACIER, BRITISH COLUMBIA

Thermal expansion

As seawater warms, its volume increases. This thermal expansion accounts for around a third of the current sea-level rise.

Glaciers and ice caps

Melting mountain glaciers contribute another third. By 2100 they'll probably add a few inches to sea level—but not feet. They don't contain that much ice.

chance that something very nasty will happen."

Even in the absence of something very nasty, coastal cities face a twofold threat: Inexorably rising oceans will gradually inundate low-lying areas, and higher seas will extend the ruinous reach of storm surges. The threat will never go away; it will only worsen. By the end of the century a hundred-year storm surge like Sandy's might occur every decade or less. Using a conservative prediction of a half meter (20 inches) of sea-level rise, the Organisation for Economic Co-operation and Development estimates that by 2070, 150 million people in the world's large port cities will be at risk from coastal flooding, along with $35 trillion worth of property—an amount that will equal 9 percent of the global GDP. How will they cope?

"DURING THE LAST ICE AGE there was a mile or two of ice above us right here," says Malcolm Bowman, as we pull into his driveway in Stony Brook, New York, on Long Island's north shore. "When the ice retreated, it left a heap of sand, which is Long Island. All these rounded stones you see—look there," he says, pointing to some large boulders scattered among the trees near his home. "They're glacial boulders."

Bowman, a physical oceanographer at the State University of New York at Stony Brook, has been trying for years to persuade anyone who will listen that New York City needs a harbor-spanning storm-surge barrier. Compared with some other leading ports, New York is essentially defenseless in the face of hurricanes and floods. London, Rotterdam, St. Petersburg, New Orleans, and Shanghai have all built levees and storm barriers in the past few decades. New York paid a high price for its vulnerability last October. Sandy left 43 dead in the city, of whom 35 drowned; it cost the city some $19 billion. And it was all unnecessary, says Bowman.

"If a system of properly designed storm-surge barriers had been built—and strengthened with sand dunes at both ends along the low-lying coastal areas—there would have been no flooding damage from Sandy," he says.

Bowman envisions two barriers: one at Throgs Neck, to keep surges from Long Island Sound



BIRTHDAY CANYON, GREENLAND

Greenland ice sheet

It's a small contributor now, but its surface has started melting in summer—a worrisome sign. The ice sheet contains enough water to raise sea level nearly 25 feet.



PINE ISLAND GLACIER, WEST ANTARCTICA

Antarctica, East and West

East Antarctica seems fairly stable. But parts of West Antarctica's ice sheet are being undermined by a warming ocean. Its future, like Greenland's, is very uncertain.

out of the East River, and a second one spanning the harbor south of the city. Gates would accommodate ships and tides, closing only during storms, much like existing structures in the Netherlands and elsewhere. The southern barrier alone, stretching five miles between Sandy Hook, New Jersey, and the Rockaway Peninsula, might cost $10 billion to $15 billion, Bowman estimates. He pictures a six-lane toll highway on top that would provide a bypass route around the city and a light-rail line connecting the Newark and John F. Kennedy Airports.

"It could be an asset to the region," says Bowman. "Eventually the city will have to face up to this, because the problem is going to get worse. It might take five years of study and another ten years to get the political will to do it. By then there might have been another disaster. We need to start planning immediately. Otherwise we're mortgaging the future and leaving the next generation to cope as best it can."

Another way to safeguard New York might be to revive a bit of its past. In the 16th-floor loft of her landscape architectural firm in lower Manhattan, Kate Orff pulls out a map of New York Harbor in the 19th century. The present-day harbor shimmers outside her window, calm and unthreatening on an unseasonably mild morning three months to the day after Sandy hit.

"Here's an archipelago that protected Red Hook," Orff says, pointing on the map to a small cluster of islands off the Brooklyn shore. "There was another chain of shoals that connected Sandy Hook to Coney Island."

The islands and shallows vanished long ago, demolished by harbor-dredging and landfill projects that added new real estate to a burgeoning city. Orff would re-create some of them, particularly the Sandy Hook–Coney Island chain, and connect them with sluice gates that would close during a storm, forming an eco-engineered barrier that would cross the same waters as Bowman's more conventional one. Behind it, throughout the harbor, would be dozens

Tim Folger wrote about tsunamis for the February 2012 issue. George Steinmetz has photographed 28 stories for the magazine, the last one on Libya.

JAMES BALOG, EXTREME ICE SURVEY (LEFT AND CENTER); MARIA STENZEL



A seawall now protects Maale, capital of the Maldives, an Indian Ocean archipelago that is the lowest, flattest country on Earth. By 2100 rising seas may force Maldivians to abandon their home. More than 100,000 live on this island, on three-quarters of a square mile.


394,000
Total population of the Maldives



Dangerously exposed to the next typhoon, squatter families crowd waterfront shanties in Manila, the Philippines. Global sea-level rise is amplified there by rapidly subsiding land.



625,000

Flood-zone squatters in Manila

of artificial reefs built from stone, rope, and wood pilings and seeded with oysters and other shellfish. The reefs would continue to grow as sea levels rose, helping to buffer storm waves—and the shellfish, being filter feeders, would also help clean the harbor. "Twenty-five percent of New York Harbor used to be oyster beds," Orff says.

Orff estimates her "oystertecture" vision could be brought to life at relatively low cost. "It would be chump change compared with a conventional barrier. And it wouldn't be money wasted: Even if another Sandy never happens, you'd have a cleaner, restored harbor in a more ecologically vibrant context and a healthier New York."

In June, Mayor Michael Bloomberg outlined a $19.5 billion plan to defend New York City against rising seas. "Sandy was a temporary setback that can ultimately propel us forward," he said. The mayor's proposal calls for the construction of levees, local storm-surge barriers, sand dunes, oyster reefs, and more than 200 other measures. It goes far beyond anything planned by any other American city. But the mayor dismissed the idea of a harbor barrier. "A giant barrier across our harbor is neither practical nor affordable," Bloomberg said. The plan notes that since a barrier would remain open most of the time, it would not protect the city from the inch-by-inch creep of sea-level rise.

CAN A SINGLE STORM CHANGE NATIONAL POLICY? IT HAPPENED IN THE NETHERLANDS IN 1953, AFTER THE DIKES FAILED AND 1,836 PEOPLE DIED.

Meanwhile, development in the city's flood zones continues. Klaus Jacob, a geophysicist at Columbia University, says the entire New York metropolitan region urgently needs a master plan to ensure that future construction will at least not exacerbate the hazards from rising seas.

"The problem is we're still building the city of the past," says Jacob. "The people of the 1880s couldn't build a city for the year 2000—of course not. And we cannot build a year-2100 city now. But we should not build a city now that we know will not function in 2100. There are opportunities to renew our infrastructure. It's not all bad news. We just have to grasp those opportunities."

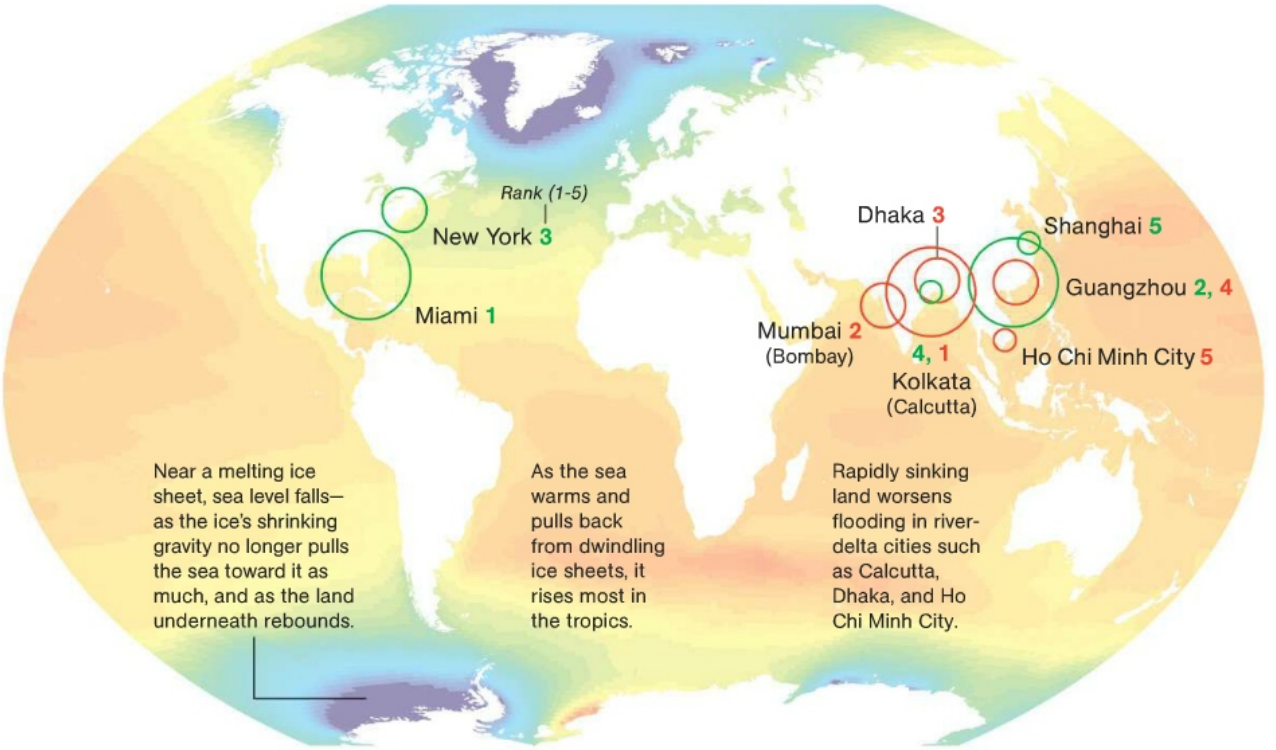
WILL NEW YORK GRASP THEM after Bloomberg leaves office at the end of this year? And can a single storm change not just a city's but a nation's policy? It has happened before. The Netherlands had its own stormy reckoning 60 years ago, and it transformed the country.

The storm roared in from the North Sea on the night of January 31, 1953. Ria Geluk was six years old at the time and living where she lives today, on the island of Schouwen Duiveland in the southern province of Zeeland. She remembers a neighbor knocking on the door of her parents' farmhouse in the middle of the night to tell them that the dike had failed. Later that day the whole family, along with several neighbors who had spent the night, climbed to the roof, where they huddled in blankets and heavy coats in the wind and rain. Geluk's grandparents lived just across the road, but water swept into the village with such force that they were trapped in their home. They died when it collapsed.

"Our house kept standing," says Geluk. "The next afternoon the tide came again. My father could see around us what was happening; he could see houses disappearing. You knew when a house disappeared, the people were killed. In the afternoon a fishing boat came to rescue us."

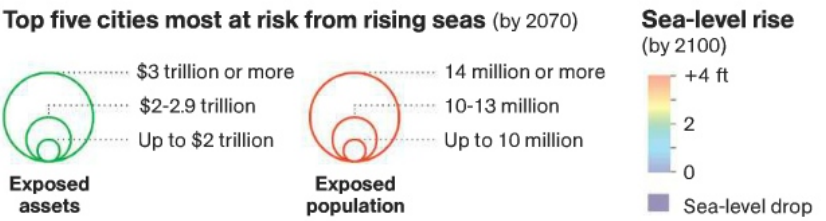
In 1997 Geluk helped found the Watersnoodmuseum—the "flood museum"—on Schouwen Duiveland. The museum is housed in four concrete caissons that engineers used to plug dikes in 1953. The disaster killed 1,836 in all, nearly half in Zeeland, including a baby born on the night of the storm.

Afterward the Dutch launched an ambitious



Uneven Impacts

If sea level rises an average of around three feet by 2100, winds, currents, and melting ice sheets will distribute the rise unevenly. Certain coastal cities will be especially vulnerable.



program of dike and barrier construction called the Delta Works, which lasted more than four decades and cost more than six billion dollars. One crucial project was the five-mile-long Oosterscheldekering, or Eastern Scheldt barrier, completed 27 years ago to defend Zeeland from the sea. Geluk points to it as we stand on a bank of the Scheldt estuary near the museum, its enormous pylons just visible on the horizon. The final component of the Delta Works, a movable barrier protecting Rotterdam Harbor and some 1.5 million people, was finished in 1997.

Like other primary sea barriers in the Netherlands, it's built to withstand a 1-in-10,000-year storm—the strictest standard in the world. (The United States uses a 1-in-100 standard.) The Dutch government is now considering whether to upgrade the protection levels to bring them in line with sea-level-rise projections.

Such measures are a matter of national security for a country where 26 percent of the land lies below sea level. With more than 10,000 miles of dikes, the Netherlands is fortified to such an extent that hardly anyone thinks about the threat from the sea, largely because much of the protection is so well integrated into the landscape that it's nearly invisible.

On a bitingly cold February afternoon I spend a couple of hours walking around Rotterdam with Arnoud Molenaar, the manager of the city's Climate Proof program, which aims to make Rotterdam resistant to the sea levels expected by 2025. About 20 minutes into our walk we climb a sloping street next to a museum

RYAN MORRIS, NGM STAFF. SOURCES: FELIX LANDERER, NASA/JPL; M. PERRETTE ET AL, 2013; ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

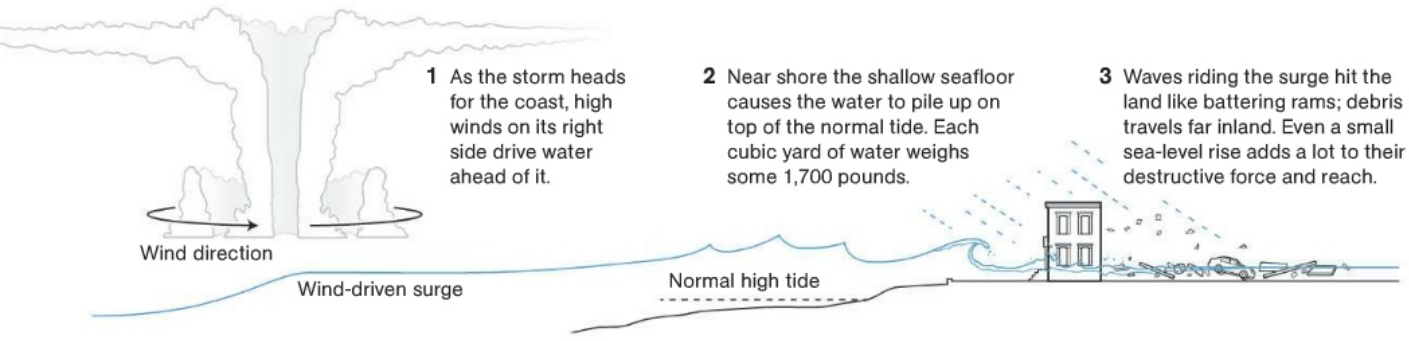


A Superstorm in 2100

What would happen to New York if the storm surge hurled at it by a storm like Sandy were riding on a sea that had risen five feet higher? That's the high end of the range in 2100 that the U.S. Army Corps of Engineers now recommends planning for. Sandy's surge flooded subway tunnels, knocked out the power grid in lower Manhattan for days, and damaged 218,000 cars in the region as a whole. If the city doesn't protect itself, a future flood will surge farther and deeper into its cavernous streets.

During Sandy, seawater gushed into the Ground Zero construction site. New federal maps include the site in a 100-year flood zone.

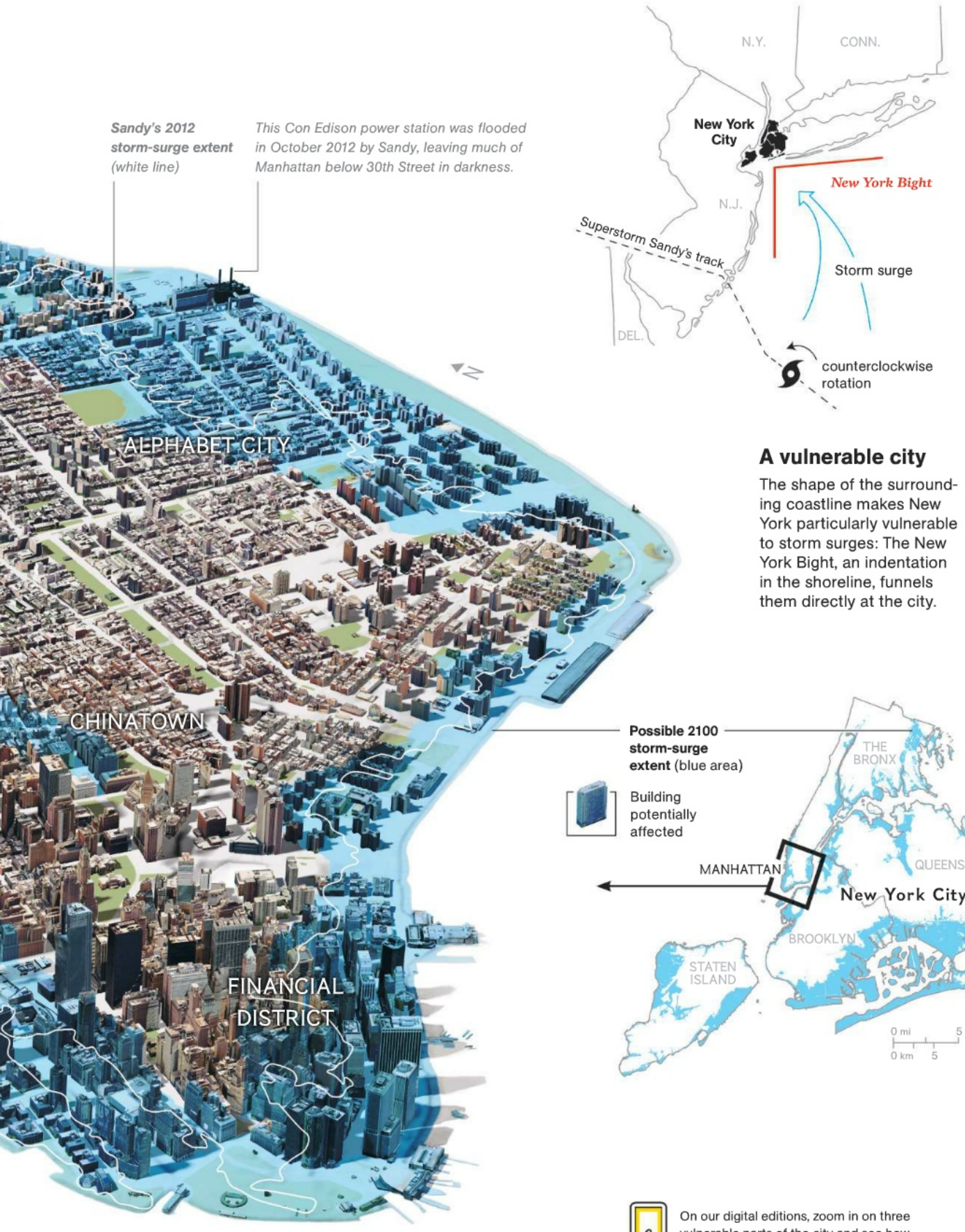
The power of a storm surge



1 As the storm heads for the coast, high winds on its right side drive water ahead of it.

2 Near shore the shallow seafloor causes the water to pile up on top of the normal tide. Each cubic yard of water weighs some 1,700 pounds.

3 Waves riding the surge hit the land like battering rams; debris travels far inland. Even a small sea-level rise adds a lot to their destructive force and reach.



A vulnerable city

The shape of the surrounding coastline makes New York particularly vulnerable to storm surges: The New York Bight, an indentation in the shoreline, funnels them directly at the city.

On our digital editions, zoom in on three vulnerable parts of the city and see how higher seas would affect a storm surge.

MANHATTAN MODEL PROVIDED BY PICTOMETRY (2009, 2012)

Methodology: This estimated footprint of a Sandy-like storm surge in 2100 assumes high tide and a sea-level rise of five feet. It was produced using a National Weather Service storm-surge model called SLOSH and a U.S. Army Corps of Engineers procedure for translating the model's coarse output into a detailed inundation map. It doesn't consider future changes in coastal terrain that would affect a storm surge, such as erosion of beaches or sandbars.

RYAN MORRIS, MATTHEW TWOMBLY, AND MAGGIE SMITH, NGM STAFF
ART: IXTRACT GMBH, BERLIN. SOURCES: NOAA; U.S. ARMY CORPS OF ENGINEERS; NEW YORK CITY DEPARTMENT OF CITY PLANNING; NEW YORK CITY OFFICE OF EMERGENCY MANAGEMENT; USGS; NATIONAL HURRICANE CENTER; NATIONAL WEATHER SERVICE; STEVENS INSTITUTE OF TECHNOLOGY (DIGITAL ELEVATION MODEL); RENAISSANCE COMPUTING INSTITUTE, UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL; FEMA (2012 STORM-SURGE EXTENT)



$6 BILLION

Cost of St. Petersburg flood barrier



Two curved steel gates, each more than 350 feet long, can swing shut to protect St. Petersburg, Russia, from Baltic Sea storms, which have flooded it repeatedly over the past three centuries. Completed in 2011, the gates are part of a 16-mile-long flood barrier that also carries a new highway.

designed by the architect Rem Koolhaas. The presence of a hill in this flat city should have alerted me, but I'm surprised when Molenaar tells me that we're walking up the side of a dike. He gestures to some nearby pedestrians. "Most of the people around us don't realize this is a dike either," he says. The Westzeedijk shields the inner city from the Meuse River a few blocks to the south, but the broad, busy boulevard on top of it looks like any other Dutch thoroughfare, with flocks of cyclists wheeling along in dedicated lanes.

As we walk, Molenaar points out assorted subtle flood-control structures: an underground parking garage designed to hold 10,000 cubic meters—more than 2.5 million gallons—of rainwater; a street flanked by two levels of sidewalks, with the lower one designed to store water, leaving the upper walkway dry. Late in the afternoon we arrive at Rotterdam's Floating Pavilion, a group of three connected, transparent domes on a platform in a harbor off the Meuse. The domes, about three stories tall, are made of a plastic that's a hundred times as light as glass.

WITH SEAS FOUR FEET HIGHER THAN TODAY, TWO-THIRDS OF SOUTHEASTERN FLORIDA IS INUNDATED. THE KEYS HAVE ALMOST VANISHED. MIAMI IS AN ISLAND.

Inside we have sweeping views of Rotterdam's skyline; hail clatters overhead as low clouds scud in from the North Sea. Though the domes are used for meetings and exhibitions, their main purpose is to demonstrate the wide potential of floating urban architecture. By 2040 the city anticipates that as many as 1,200 homes will float in the harbor. "We think these structures will be important not just for Rotterdam but for many cities around the world," says Bart Roeffen, the architect who designed the pavilion. The homes of 2040 will not necessarily be domes; Roeffen chose that shape for its structural integrity and its futuristic appeal. "To build on water is not new, but to develop floating communities on a large scale and in a harbor with tides—that is new," says Molenaar. "Instead of fighting against water, we want to live with it."

While visiting the Netherlands, I heard one joke repeatedly: "God may have built the world, but the Dutch built Holland." The country has been reclaiming land from the sea for nearly a thousand years—much of Zeeland was built that way. Sea-level rise does not yet panic the Dutch.

"We cannot retreat! Where could we go? Germany?" Jan Mulder has to shout over the wind—we're walking along a beach called Kijkduin as volleys of sleet exfoliate our faces. Mulder is a coastal morphologist with Deltares, a private coastal management firm. This morning he and Douwe Sikkema, a project manager with the province of South Holland, have brought me to see the latest in adaptive beach protection. It's called the *zandmotor*—the sand engine.

The seafloor offshore, they explain, is thick with hundreds of feet of sand deposited by rivers and retreating glaciers. North Sea waves and currents once distributed that sand along the coast. But as sea level has risen since the Ice Age, the waves no longer reach deep enough to stir up sand, and the currents have less sand to spread around. Instead the sea erodes the coast here.

The typical solution would be to dredge sand offshore and dump it directly on the eroding beaches—and then repeat the process year after year as the sand washes away. Mulder and his colleagues recommended that the provincial government try a different strategy: a single gargantuan dredging operation to create the sandy peninsula we're walking on—a hook-shaped stretch of beach the size of 250 football fields. If the scheme works, over the next 20 years the wind, waves, and tides will spread its sand 15 miles up and down the coast. The combination of wind, waves, tides, and sand is the zandmotor.

The project started only two years ago, but it seems to be working. Mulder shows me small dunes that have started to grow on a beach where there was once open water. "It's very flexible," he says. "If we see that sea-level rise increases, we can increase the amount of sand." Sikkema adds, "And it's much easier to adjust the amount of sand than to rebuild an entire system of dikes."

Later Mulder tells me about a memorial inscription affixed to the Eastern Scheldt barrier in Zeeland: "It says, *'Hier gaan over het tij, de maan, de wind, en wij*—Here the tide is ruled by the moon, the wind, and us.'" It reflects the confidence of a generation that took for granted, as we no longer can, a reasonably stable world. "We have to understand that we are not ruling the world," says Mulder. "We need to adapt."

WITH THE THREATS OF CLIMATE CHANGE and sea-level rise looming over us all, cities around the world, from New York to Ho Chi Minh City, have turned to the Netherlands for guidance. One Dutch firm, Arcadis, has prepared a conceptual design for a storm-surge barrier in the Verrazano Narrows to protect New York City. The same company helped design a $1.1 billion, two-mile-long barrier that protected New Orleans from a 13.6-foot storm surge last summer, when Hurricane Isaac hit. The Lower Ninth Ward, which suffered so greatly during Hurricane Katrina, was unscathed.

"Isaac was a tremendous victory for New Orleans," Piet Dircke, an Arcadis executive, tells me one night over dinner in Rotterdam. "All the barriers were closed; all the levees held; all the pumps worked. You didn't hear about it? No, because nothing happened."

New Orleans may be safe for a few decades, but the long-term prospects for it and other low-lying cities look dire. Among the most vulnerable is Miami. "I cannot envision southeastern Florida having many people at the end of this century," says Hal Wanless, chairman of the department of geological sciences at the University of Miami. We're sitting in his basement office, looking at maps of Florida on his computer. At each click of the mouse, the years pass, the ocean rises, and the peninsula shrinks. Freshwater wetlands and mangrove swamps collapse—a death spiral that has already started on the southern tip of the peninsula. With seas four feet higher than they are today—a distinct possibility by 2100—about two-thirds of southeastern Florida is inundated. The Florida Keys have almost vanished. Miami is an island.

When I ask Wanless if barriers might save Miami, at least in the short term, he leaves his office for a moment. When he returns, he's holding a foot-long cylindrical limestone core. It looks like a tube of gray, petrified Swiss cheese. "Try to plug this up," he says. Miami and most of Florida sit atop a foundation of highly porous limestone. The limestone consists of the remains of countless marine creatures deposited more than 65 million years ago, when a warm, shallow sea covered what is now Florida—a past that may resemble the future here.

A barrier would be pointless, Wanless says, because water would just flow through the limestone beneath it. "No doubt there will be some dramatic engineering feats attempted," he says. "But the limestone is so porous that even massive pumping systems won't be able to keep the water out."

Sea-level rise has already begun to threaten Florida's freshwater supply. About a quarter of the state's 19 million residents depend on wells sunk into the enormous Biscayne aquifer. Salt water is now seeping into it from dozens of canals that were built to drain the Everglades. For decades the state has tried to control the saltwater influx by building dams and pumping stations on the drainage canals. These "salinity-control structures" maintain a wall of fresh water behind them to block the underground intrusion of salt water. To offset the greater density of salt water, the freshwater level in the control structures is generally kept about two feet higher than the encroaching sea.

But the control structures also serve a second function: During the state's frequent rainstorms their gates must open to discharge the flood of fresh water to the sea. "We have about 30 salinity-control structures in South Florida,"

The Netherlands: Low Country, Long View

For nearly a thousand years the Dutch have been reclaiming land from the sea—and occasionally losing some. A catastrophic flood that killed more than 1,800 people in 1953 spurred the country to develop the world's most elaborate and sophisticated system of dikes and other defenses. The most critical structures are built to withstand a 1-in-10,000-year storm.



Land of windmills and dikes

Flanked by windmills, this dike protects farmland that is almost entirely below sea level. Dikes and continuous pumping keep more than a quarter of the country from reverting to swamp or open water.

says Jayantha Obeysekera, the chief hydrological modeler at the South Florida Water Management District. "At times now the water level in the sea is higher than the freshwater level in the canal." That both accelerates saltwater intrusion and prevents the discharge of flood waters. "The concern is that this will get worse with time as the sea-level rise accelerates," Obeysekera says.

Using fresh water to block the salt water will eventually become impractical, because the amount of fresh water needed would submerge ever larger areas behind the control structures, in effect flooding the state from the inside. "With 50 centimeters [about 20 inches] of sea-level rise, 80 percent of the salinity-control structures in Florida will no longer be functional," says Wanless. "We'll either have to drown communities to keep the freshwater head above sea level or have saltwater intrusion." When sea level rises two feet, he says, Florida's aquifers may be poisoned beyond recovery. Even now, during unusually high tides, seawater spouts from sewers in Miami Beach, Fort Lauderdale, and other cities, flooding streets.

In a state exposed to hurricanes as well as rising seas, people like John Van Leer, an oceanographer at the University of Miami, worry that one day they will no longer be able to insure—or sell—their houses. "If buyers can't insure it, they can't get a mortgage on it. And if they can't get a mortgage, you can only sell to cash buyers," Van Leer says. "What I'm looking for is a climate-change denier with a lot of money."

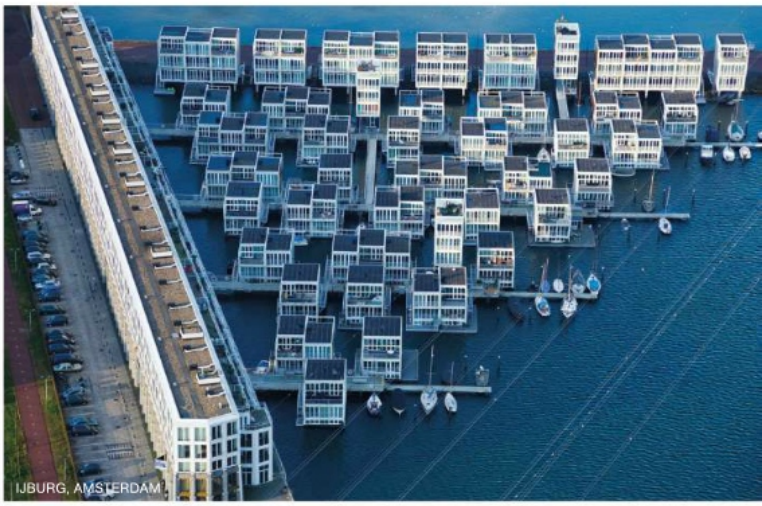
UNLESS WE CHANGE COURSE dramatically in the coming years, our carbon emissions will create a world utterly different in its very geography from the one in which our species evolved. "With business as usual, the concentration of carbon dioxide in the atmosphere will reach around a thousand parts per million by the end of the century," says Gavin Foster, a geochemist at the University of Southampton in England. Such concentrations, he says, haven't been seen on Earth since the early Eocene epoch, 50 million years ago, when the planet was completely ice free. According to the U.S. Geological Survey, sea level on an iceless Earth would be as much



KAMPEN, OVERIJSSEL

Dike watchers

The control of dikes—and the power to levy taxes to maintain them—rests with community water boards that predate the existence of the Netherlands as a nation. These volunteers are trained to contain a breach within three hours.


IJBURG, AMSTERDAM

At home on the water

Small docks and communal walkways link the floating houses built on a lake in east Amsterdam. Secured by sliding collars to steel pilings, the houses can rise and fall during floods and storms.

as 216 feet higher than it is today. It might take thousands of years and more than a thousand parts per million to create such a world—but if we burn all the fossil fuels, we will get there.

No matter how much we reduce our greenhouse gas emissions, Foster says, we're already locked in to at least several feet of sea-level rise, and perhaps several dozens of feet, as the planet slowly adjusts to the amount of carbon that's in the atmosphere already. A recent Dutch study predicted that the Netherlands could engineer solutions at a manageable cost to a rise of as much as five meters, or 16 feet. Poorer countries will struggle to adapt to much less. At different times in different places, engineering solutions will no longer suffice. Then the retreat from the coast will begin. In some places there will be no higher ground to retreat to.

By the next century, if not sooner, large numbers of people will have to abandon coastal areas in Florida and other parts of the world. Some researchers fear a flood tide of climate-change refugees. "From the Bahamas to Bangladesh and a major amount of Florida, we'll all have to move, and we may have to move at the same time," says Wanless. "We're going to see civil unrest, war. You just wonder how—or if—civilization will function. How thin are the threads that hold it all together? We can't comprehend this. We think Miami has always been here and will always be here. How do you get people to realize that Miami—or London—will not always be there?"

What will New York look like in 200 years? Klaus Jacob, the Columbia geophysicist, sees downtown Manhattan as a kind of Venice, subject to periodic flooding, perhaps with canals and yellow water cabs. Much of the city's population, he says, will gather on high ground in the other boroughs. "High ground will become expensive, waterfront will become cheap," he says. But among New Yorkers, as among the rest of us, the idea that the sea is going to rise—a lot—hasn't really sunk in yet. Of the thousands of people in New York State whose homes were badly damaged or destroyed by Sandy's surge, only 10 to 15 percent are expected to accept the state's offer to buy them out at their homes' pre-storm value. The rest plan to rebuild. □





An abandoned house still stands on Tiengemeten Island in South Holland, where the government intentionally broke the dikes to create a rare slice of wilderness in a country shaped by humans.



A cassowary peers through foliage in northeast Queensland, Australia. Females like this one can weigh 160 pounds. No one knows what the casque on her head is for, but it could be a sexual ornament.

Big Bird

In the far north of Australia the cassowary plays a central role in shaping the rain forest.

By Olivia Judson

Photographs by Christian Ziegler





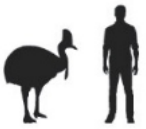
Adult cassowaries keep company with each other only during the breeding season. A male (at left) is distinguished by his smaller size. His shaggy feathers are perfect for snuggling chicks.







As part of her courting ritual, this female cassowary turns a puddle into a love tub, bringing prospective mates in for a bath. Big, old females like this one typically have the most impressive casques.



On the ground in front of me there's a large round pile of what looks like moist purple mud. It's roughly the volume of a baseball cap, and it's studded with berries and seeds—more than 50. Some of the seeds are larger than an avocado stone.

I kneel down to look more closely. Putting my nose just a couple of inches away, I take a sniff. It smells of fruit mixed with a whiff of vinegar. There's also a hint of that mouth-puckering, astringent flavor you get from strong black tea. Peculiar. But not unpleasant.

What is it? It's a bird dropping. A big bird dropping. From a big bird.

I stand up and look around. I'm in the Daintree Rainforest, two hours' drive up the coast from the seaside city of Cairns, in the far north of Australia. Here and there, shafts of sunlight fall through the canopy, dappling the ground. On a tree beside me, I spot a Boyd's forest dragon—a handsome lizard with a crest on its head and spikes down its spine. Somewhere nearby, insects are singing. But of a big bird—no sign.

Probably I wouldn't see it even if it was right there, just through those trees. Despite its bigness, it blends in with the shadows of the forest.

The bird in question? *Casuarius casuarius,* the southern cassowary, fruit-eater-in-chief of Australia's rain forests.

CASSOWARIES ARE LARGE, flightless birds related to emus and (more distantly) to ostriches, rheas, and kiwis. Today there are three species. Two are confined to the rain forests of New Guinea and nearby islands. The third and largest—the southern cassowary—also lives in the Wet Tropics of northern Queensland, in the part of Australia that sticks up at New Guinea like a spike. Some live deep in tracts of rain forest, such as the Daintree; others live on the forest edge and may wander through people's backyards.

But a cassowary is not your regular garden bird. If an adult male stretches up to his full height, he can look down on someone five feet five—i.e., me—and he may weigh more than 110 pounds. Adult females are even taller, and can weigh more than 160 pounds. Among living birds, only ostriches are more massive. Most of the time, however, cassowaries seem smaller than they are, because they don't walk in the stretched-up position but slouch along with their backs parallel to the ground.

Their feathers are glossy black; their legs are scaly. Their feet have just three toes—and the inside toe of each foot has evolved into a formidable spike. Their wings are tiny, having shrunk almost to the point of nonexistence. But their necks are long, and bare of all but the lightest coating of short, hairlike feathers. Instead the skin is colored with amazing hues of reds and oranges, purples and blues. At the base of the neck in the front, a couple of long folds of colorful skin, known as wattles, hang down. Cassowaries have large brown eyes and a long, curved beak. On their heads they wear a tall, hornlike casque.

You need only see two or three to know that unlike, say, sparrows, cassowaries can easily be recognized as individuals. This one has splendid long wattles and a straight casque; that one has a casque that curves rakishly to the right. This clear individuality, together with their size and the fact that they do not fly, makes them strangely humanlike: They move like people, they are people-size, and they are easy to tell apart. Because of this, it's common for people to give them names—such as Crinklecut, Big



Fruits of the Australian rain forest. Male cassowaries raise the chicks, teaching them what to eat.

Bertha, or Dad. It might also explain why they have long figured in the mythologies of rain forest tribes. Some believe that cassowaries are cousins of humans; others, that they are people who have been reincarnated; still others, that humans were created from the feathers of a female. However, unlike in humans, males do all the child care—they sit on the eggs, and look after the chicks for nine months or more—so they also inspire envy. "I'm coming back as a female cassowary!" one mother of five told me.

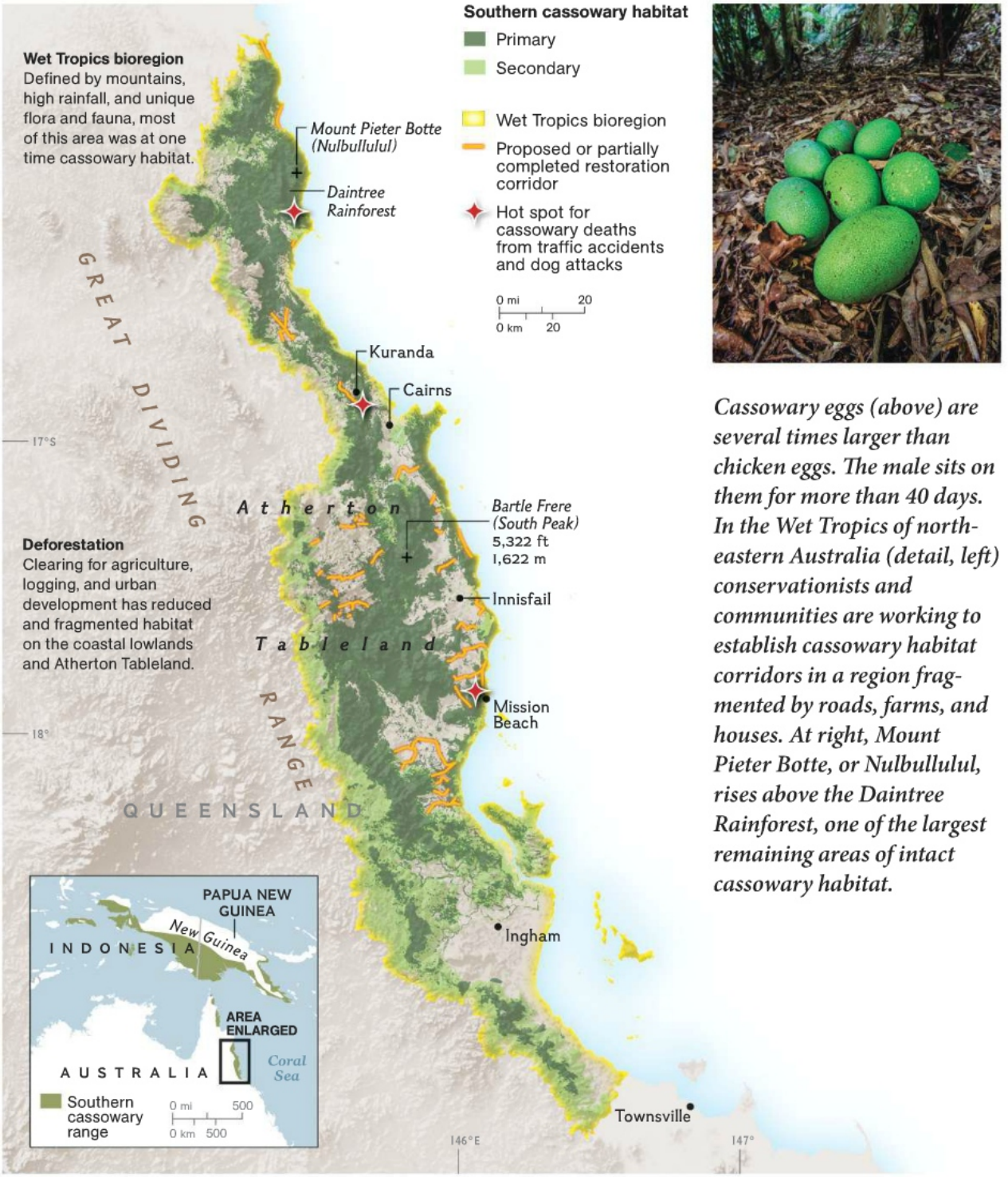
Adding to their mystique, cassowaries have a reputation for being dangerous. And certainly if you keep them in a pen and rush at them with a rake—which, judging by videos posted on YouTube, some people do—they are. They are big, they have claws and a powerful kick, and they will use them. If cassowaries come to associate humans with food handouts, they can become aggressive and demanding. If you get close to a male with young chicks, he may charge you in an attempt to protect them. If you try to catch or kill a cassowary, it may fight back—and could well get the better of you. They sometimes kill dogs.

But let's get this straight. Left to themselves and treated with respect, cassowaries are shy, peaceable, and harmless. In Australia the last recorded instance of a cassowary killing a person was in 1926—and that was in self-defense.

DAD HAS A TERRITORY near Kuranda, a small town in the hills behind Cairns; he has lived here for at least 30 years. His territory includes a patch of dense forest, a road, and the garden of Cassowary House, a guesthouse where I'm staying for a few days. Despite the summer heat, the bed has an electric blanket—to keep the sheets dry in the sodden rain forest air. And while I sit on a veranda drinking coffee, Dad and his three chicks stroll about below.

Dad's casque veers off at an angle and looks a bit mangled. His chicks, which are about four weeks old and almost knee-high, make funny whistling-peeping sounds as they run about. He mostly stays silent—but from time to time clacks his bill, making a loud banging noise. He burps too. And occasionally he booms. That is,

Olivia Judson's story on Antarctica's Mount Erebus appeared in the July 2012 issue. Christian Ziegler's photograph on pages 70-71 was awarded first prize, Nature, in the 2013 World Press Photo contest.



Cassowary eggs (above) are several times larger than chicken eggs. The male sits on them for more than 40 days. In the Wet Tropics of northeastern Australia (detail, left) conservationists and communities are working to establish cassowary habitat corridors in a region fragmented by roads, farms, and houses. At right, Mount Pieter Botte, or Nulbullulul, rises above the Daintree Rainforest, one of the largest remaining areas of intact cassowary habitat.

he tucks his head down low, inflates his neck, and makes a series of low booming noises. As he does this, his feathers puff up. When he sits down, the chicks cuddle up to him, often snuggling into his feathers.

The chicks have obviously different temperaments. One is adventurous, and wanders far from the family group; sometimes this triggers booming from Dad. Another chick is timid, and keeps close to Dad. This one often seeks its father's attention. Now and then they touch the tips of their bills together—a cassowary kiss?—but the contact seems to be instigated by the chick, not the father. The chick also picks ticks off its father's neck and eats them. Yum.

Dad and the chicks seem to follow a loose routine. They eat in the morning, rest during the hot part of the day, and eat again toward dusk. Sometimes they go for a bath in a creek. A bird of prey—a goshawk—has a nest high in a nearby

JEROME N. COOKSON, NGM STAFF. SOURCES: QUEENSLAND DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION; WET TROPICS MANAGEMENT AUTHORITY; IUCN



tree, and often the cassowaries stop underneath to see if any food—a dead lizard or perhaps a snake—has been dropped. If it has, they eat it.

But mostly they feast on fruit. In the course of a day a single adult cassowary eats hundreds of fruits and berries. Cassowary digestion is gentle, though, and does not harm the seeds, which emerge intact. And so, as a cassowary wanders through its territory, eating, drinking, bathing, and defecating, it moves seeds from one part of the forest to another—sometimes over distances of half a mile or more. It also moves seeds up hills and across rivers. In short, it transports seeds in ways that gravity alone cannot. By means of their fruit-scented droppings, then, cassowaries are a powerful vehicle for spreading seeds around.

And for a lot of trees, cassowaries are the only vehicle. Australia does have other fruit-eaters—small birds, bats, and marsupials such as the musky rat kangaroo, a furry creature with a pointed face, big ears, and a long, naked tail—but these are too small to carry big fruits very far. And in the rain forest, many trees produce big, heavy fruits with big, heavy seeds, because such seeds grow better in the gloom of the forest floor.

As animals roam around, eating fruit and passing seeds, they create the forest of the future: They give plants new places to grow. Thus, as fruit-eaters-in-chief, cassowaries are also chief architects of the forest.

They help some plants to sprout too. *Ryparosa kurrangii,* for example, is a tree known only from a small region of Australia's coastal rain forest. One study showed that without passing through a cassowary, only 4 percent of *Ryparosa* seeds grow; after passing through a cassowary, 92 percent do. (Why this makes such a difference is not known.)

And so, if the cassowary were to vanish, the structure of the forest would gradually change. Trees of some species would become less widespread, and some species would probably disappear altogether. Which would be a shame. The rain forests of the far north of Australia, such as the Daintree, are relicts from the ancient supercontinent of Gondwana. That is, many of the plants are descendants of those that lived in rain forests that once covered much of Australia and Antarctica, way back, 100 million years ago, when the two continents were sutured together. As such, they are a living museum, a riot of evolutionary pathways, a showcase of different ways to be a plant. There are ferns that look like coconut palms—tall, thin trunks crowned with long, frondlike leaves—and palms with leaves



A male cassowary feasts on quandongs, a favorite fruit. To eat, the bird picks one up with the tip of its bill, then tosses its head and opens its bill wide, throwing the whole fruit down its throat.





A chick rushes to find a fruit it heard dropping to the ground. Cassowaries can move fast. If startled, adults can run more than 30 miles an hour. So you don't want to be chased by one.





A chick finds comfort in its father's feathers. Newly hatched cassowaries are covered in striped fuzz. Even the youngest chicks have tiny protowattles, and a shiny flat spot on their heads where the casque will grow.

like huge Japanese fans. There are trees on trees, and orchids on trees, and way up high, ferns like baskets.

UNFORTUNATELY, however, there's less of this original forest than there used to be. And as the forest has dwindled, so has the cassowary.

How many are left? This is the most contentious question in cassowary biology. In Australia the bird is listed as endangered; most tallies put the number of cassowaries around 1,500 to 2,000. But these are guesstimates: No one knows for sure.

The trouble is, cassowaries are hard to count. They live alone, in dense forests. Attempts to estimate numbers based on DNA taken from droppings have not been published. Nor have estimates based on photographs of individuals coming to emergency feeding stations set up after cyclones. So it's not clear if the population is rising or falling—or how close to extinction the birds really are.

What is clear is that cassowaries have problems. Just as cassowaries sometimes kill dogs, dogs sometimes kill cassowaries—especially young birds. Feral pigs may destroy cassowary nests, and cassowaries sometimes die in pig traps. Another hazard is traffic. While I was visiting, one of Dad's chicks narrowly escaped being hit by a truck. And in Mission Beach, a pretty seaside town south of Cairns, several cassowaries are killed on the roads every year.

I saw one victim, lying in the back of a pickup truck belonging to the Queensland Parks and Wildlife Service; the ranger had collected it right after the accident was called in. It was a young female, just on the edge of sexual maturity. Her casque was small, and she still had a few brown feathers. The bed of the truck was smeared with blood, and muck was oozing out of her mouth. Her legs were scraped. Her eyes were open but unseeing.

I reached over and touched her. The skin on her neck was velvety. And her casque was not hard, as I had expected, but spongy. Seen up close, her feet looked huge.

The ranger was visibly upset, and talked in a steady stream about local cassowary politics, explaining how some groups want to fence off the roads and build underground tunnels for cassowaries to use, while others argue this won't



A pair of chicks parade past a doorway near Kuranda in northeast Queensland. They have outgrown their fuzz but will not sport a full coat of adult black feathers until they reach sexual maturity, around age four.

work, and lobby instead for lower speed limits and more cassowary-crossing signs. "There have been three dead birds in the last six weeks," he said. He lifted the body out of the truck and put it in a freezer, to await an autopsy. As he did so, another cassowary appeared from behind a building, a jarring contrast between the majesty of the living and the mangled body of the dead.

Roads also carve up the forest. And as the forest becomes more fragmented, it becomes harder for young cassowaries to find their own territories. Because these birds are so territorial, it takes a certain amount of suitable habitat to sustain a population at all. Which brings me to the other big problem: development. In Mission Beach a development called Oasis is typical. It has paved streets with names like Sandpiper Close, lined with streetlamps. But there are no houses yet: just empty lots, the grass neatly mown, garnished with For Sale signs. The only inhabitants are a flock of ibises, sheltering from the sun in the shade of the few remaining trees. And Dad doesn't know it, but his forest has been put up for sale, which could see it cut down to make way for houses. Some locals are trying to prevent all this—clubbing together to buy land to create nature preserves, replanting rain forest trees on cleared land, and lobbying farmers not to cut down forest. The hope is to link forest fragments, so that young cassowaries looking for territories can move from one fragment to another without having to cross the open fields of sugarcane plantations, or big highways. For the cassowary depends on the forest even more than the forest depends on the cassowary.

I want to leave you with a final image. I'm in the Daintree, the most intact piece of remaining forest. I'm standing by a fig tree, hoping to see Crinklecut—a young male—and his two chicks. Crinklecut's territory overlaps that of Big Bertha, an enormous and regal female that is probably the chicks' mother. A human family lives here too, with three children, plus a giant green tree frog that's moved into the kitchen and lives in a frying pan. Suddenly the youngest of the children comes tearing through the trees to tell me that Crinklecut and his chicks are on their way to a nearby creek. As I come within sight of them, Crinklecut stretches up to his full height and looks at me. Then he and his chicks stroll off, into the dusk. □



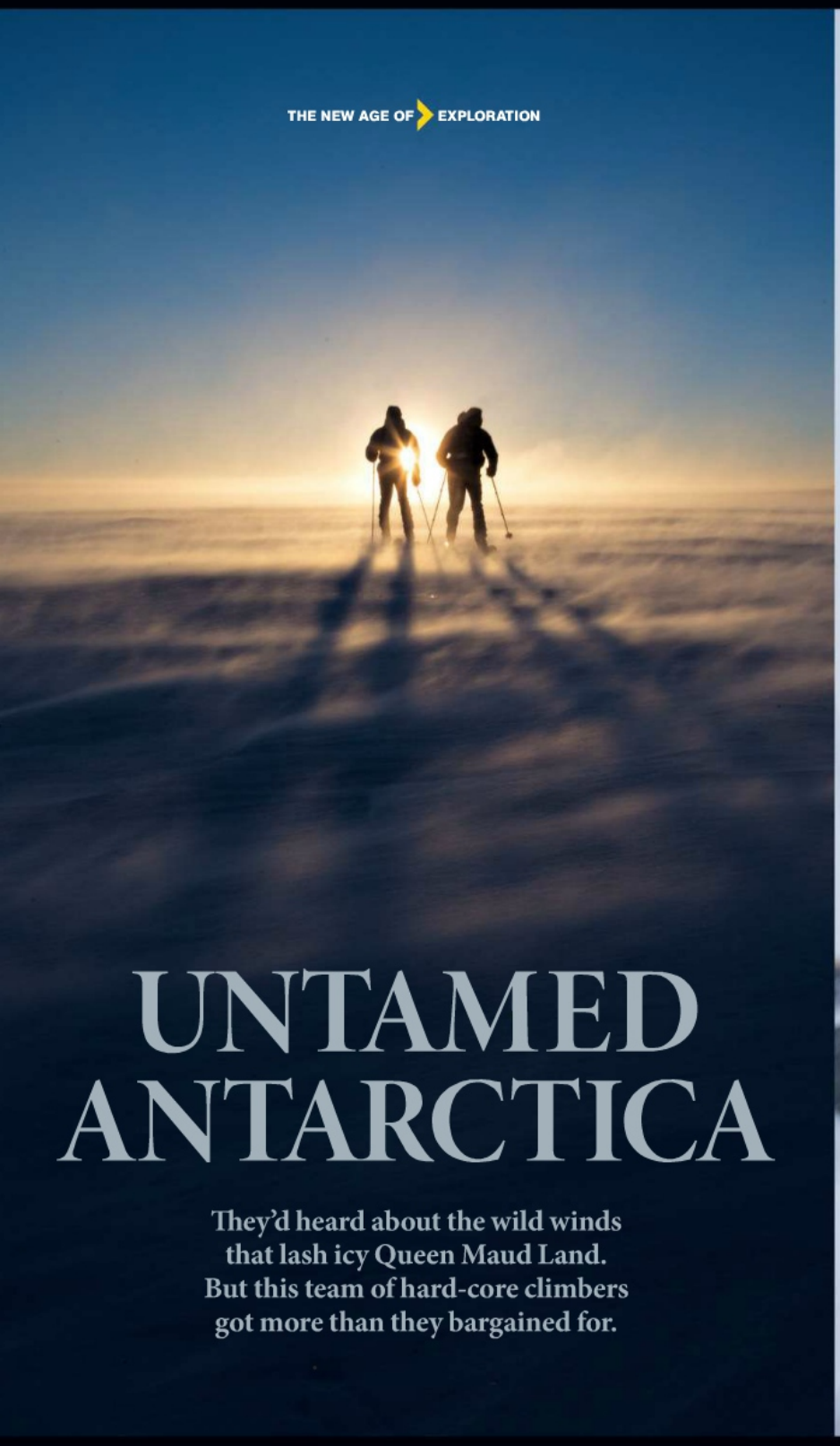
On a beach south of Cairns a young chick hurries to keep close to its father. If all goes well, they will stay together for about nine months, until the father decides to mate again and raise another brood.







Suspended from an anchor in the rock hundreds of feet above the ice and snow, Mike Libecki hauls himself up a granite tower in remote Queen Maud Land.



UNTAMED ANTARCTICA

They'd heard about the wild winds that lash icy Queen Maud Land. But this team of hard-core climbers got more than they bargained for.



Libecki stops to rest in a blizzard, bandages covering patches of frostnip. "Imagine living in your freezer for a month," he says.


MOUNTAIN
HARD
WEAR

By Freddie Wilkinson
Photographs by Cory Richards

The rumbling outside my tent sounds more like an earthquake than the wind.

I instinctively flinch, burrowing deeper into my sleeping bag. I've faced terrifying winds before: the roar of the jet stream in the Himalaya at night, the fearsome howl of a Patagonian tempest. This is worse.

The ground shakes as the next surge races toward me. My tent is lashed between two boulders in a desolate wilderness deep in the Wohlthat Mountains of Antarctica. My three teammates are hunkered down nearby. Fifty miles to the south is the edge of the Polar Plateau, the vast frozen upland that dominates the continent's interior. Geography and gravity combine here to unleash powerful katabatic winds—dense waves of cold air that rush down mountain corridors like avalanches tumbling toward the sea.

The next blast hits. The poles of my tent arch inward, collapsing the fabric above my sleeping bag. For a moment I register the machine-gun rattle of stitching tearing. Suddenly I'm spinning, flying through the air, flipped upside down. Still inside my tent, I'm picked up by the wind and thrown against a crude stone wall I had built for protection, then tossed right over it. Books, camera gear, and dirty socks are thrown about indiscriminately. Down feathers flutter from my sleeping bag.

My neck and shoulder tingle. Crawling toward a slash in the tent, I grab the fabric and rip the hole wider. Shards of sand and spindrift



A knob of rock offers scant protection in the Westliche Petermann Range. Team members used skis to anchor tents, but fierce winds tore them loose anyway—sometimes flipping them as the occupants lay inside—while deep snowdrifts swallowed gear.



sting my eyes as I stick my head out and cry into the melee.

"Help!"

COMING TO ANTARCTICA was Mike Libecki's idea. Equal parts California surfer dude and hard-edged adventurer, Libecki, 40, has made dozens of first ascents around the world. Tall and soft-spoken, with swatches of gray in his blond hair, he projects a relentlessly positive energy. "I've been there before," he said of the region known as Queen Maud Land, where only scientists usually venture. "I've got the keys to the castle."

Libecki also recruited a pair of seasoned climber photographers to go with us: Keith Ladzinski, a bushy-browed Coloradan, and Cory Richards, a Utah native with a devilish grin. Our plan would be to find the highest concentration of unclimbed peaks in the region, and then make as many first ascents as we dared.

We begin our journey in early November, landing at a blue-ice runway near a Russian research station named Novolazarevskaya. "Last time I was

This is Freddie Wilkinson's first story for the magazine. Cory Richards covered cave exploration in Nepal for the October 2012 issue.

here, I peeled potatoes in the kitchen to help pay for the trip," Libecki says of his visit eight years ago. The head of the station welcomes us with toasts from a bottle of home-brewed black plum whiskey. Despite the industrial-style accommodations, a sense of happy purpose seems to unite everyone at the station, from the scientific teams to the kitchen staff and mechanics.

"There are no casualties, no car wrecks, and no bullets here," Benjamin Novikov says over a cup of tea in the mess. A retired surgeon from St. Petersburg, Novikov serves as the camp doctor. "We are living on our own, facing elements, and everyone behaves in the proper way. We tell our families we come for the money. But really, we come to escape."

For five days we bide our time as a storm batters the camp. Then on the sixth we load our gear aboard a converted DC-3 and leave the Russians behind. Once airborne the four of us crowd forward to gaze out the cockpit windows. A dark phalanx of rocks stretches to the horizon. As we fly closer, what first appeared to be a monolithic wall turns out to be a series of mountain ranges, great stone divides cleaving glacier systems flowing from the Polar Plateau. Soaring cliffs and needle-sharp towers appear. A tooth of rock rising off our left wing looks familiar: It's the same spire Libecki had photographed years before. We've found our target.

Within seconds he's accelerating cross-country like a cowboy atop a runaway horse. Sinking lower in his kite harness, he widens his stance to regain control.

AN HOUR LATER we're standing on the glacier as the plane lifts off again. We listen to its drone fade into the distance. For the next five weeks our only link to civilization will be our satellite phone. Picking up shovels and saws, we start constructing a camp from blocks of hard snow. By late afternoon we've cobbled together a circular barrier 5 feet tall and 30 feet in diameter. A skirmish line of low clouds appears as we settle in for the night.

The next afternoon the wind teaches us another lesson. To help us cover as much ground as we can, Libecki has brought along kites to pull us on our skis. But as we set off to scout the most promising peaks, the swirling gusts refuse to cooperate. We watch as Libecki gamely unfurls one of the small wings of parachute cloth and launches it into the air. Within seconds he's accelerating cross-country like a cowboy atop a runaway horse. Sinking lower in his harness, he widens his stance to regain control. But after a couple hundred yards he purposefully drops flat, body-slamming the hard surface of snow to check his speed. The wind wrenches the kite's bar from his grip. Luckily it catches on a protruding piece of snow a hundred yards away. We pack up the kites for another day.

There are plenty of tempting climbs here: a cluster of tack-sharp rock pyramids we dub the Fortresses; a 3,000-foot wall of rock soaring from the ice that we call the Ship Prow; a peak resembling a lighthouse; and a big triangular wall we name the Sail. But by the time we complete our two-week tour, we all agree that our first objective must be the slender spire directly behind our camp.

Like a massive tooth of wind-carved stone, the peak holds no snow. Facing northwest, the wall above our camp is infused with red swirls and mysterious pockmarks. To the left, facing east—the side that catches the wind—the wall is marble gray and rounded smooth like the hull of an aircraft carrier. The two faces converge in a sharp pillar of rock, jutting due north. We can only guess how tall the spire is from base to summit: perhaps 2,000 feet, maybe more.

As I stand below it, my blood tingles with nervous excitement. This is *(Continued on page 94)*

Society Grant This expedition was funded in part by your National Geographic Society membership.



Islands of Stone

Drawn to the remote Wohlthat Mountains by their dramatic granite walls and spires, Libecki and his team spent a week circling potential climbing targets before making what they believe were two first ascents. Through windstorms, cold, and frustrating delays, Libecki says, the team was driven by three powerful emotions: "obsession, optimism, joy."



Searing as a sandstorm, a ground blizzard lashes the ice. Parts of this region are so dry, it's sometimes called a cold desert.







Loose rock and frigid winds slowed the ascent of a 2,000-foot spire the climbers named Bertha's Tower. They took ten days, advancing a rope's length a day.



A team member (at lower right) approaches Bertha's Tower. During their ascent of the peak, the climbers followed the sharp line between sun and shade.

KEITH LADZINSKI



what we came for, a chance to complete a first ascent in this otherworldly frontier. But we've already had a taste of the katabatic winds on flat ground. What would happen if they return while we're up on the wall? Libecki, naturally, wants to start climbing immediately.

Our strategy is for Richards, Libecki, and me to fix ropes to a bivouac on a ledge about two-thirds of the way up, while Ladzinski photographs us from below. But the wind fights us at every stage, and it takes us two weeks just to reach the ledge.

Our new home is a perch the size of a farmer's porch, 1,200 feet off the ground. One evening at dinner Richards tosses a few stones off the edge. They tumble through space for 20 long seconds before hitting the surface with a crackle of dust, having never touched the wall.

I've never lost a tent to a storm. On this trip we've lost three: two buried in snow and the third flipped upside down as I lay inside. Libecki pulled me from my tattered shelter.

"Who's taking low bunk tonight?" he asks, joking. Our portaledge shelter, a cross between a tent and a cot attached to the wall, holds only two, so someone must spend the night outside, with just a sleeping bag for protection from the elements. The flattest piece of real estate is a nook inches from the void. I sigh and volunteer.

For the next three days we make steady progress, fixing ropes up the spire and returning to the ledge each night. But we know how exposed we are here if the howling winds return. In a decade of climbing I've never lost a tent to a storm. On this trip we've lost three: two buried in snow and the third flipped upside down as I lay inside. Libecki pulled me from my tattered shelter after hearing my call for help. He was laughing as he did so.

Now, with time running out, Libecki asks for our attention as he chews his dinner ration of cheese. "You know, my grandmother told me the time is now," he says. "I got that from her. We used to ask, 'Grandma Bertha, what time is it?' And she'd always say, 'The time is now, goddamn it!'"

With any luck, he says, we could reach the summit soon.

The next morning it's my turn to lead. As I ascend the rope to where we left off, the overhanging rock leaves me dangling 1,600 feet off the ground. Libecki belays me, prepared to hold the rope fast should I fall. Searching for the best holds with my gloved fingers, I make my first tentative moves on the vertical rock face. To reach the top I must cross the most exposed section of the entire pillar.

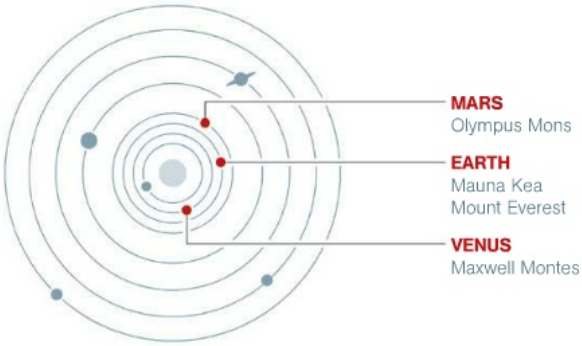
"Watch me—this is getting weird," I call down to Libecki, as I reach for a more promising line of cracks. A sudden downdraft surges past me, tugging the rope between us. If there's one thing we've learned, it's that a sudden burst of katabatics can strike at any time, even on the nicest days. I swallow my doubts and let the crack lead me over a bulge and across an improbable slab, higher into the sky.

The very top of the slender spire we would later name Bertha's Tower is a mushroom rock the size of a coffee table. I stand on its head and see, far below, the tiny yellow speck of my tent. In the other direction the Fortresses blaze blood-red in the evening light. The sky above is overcast, the air unexpectedly still. Everything in this wilderness—the glaciers, the towers, the distances in between—has proved a far greater challenge than we expected. Yet the four of us have faced it alone.

The wind can take you prisoner, I think, or it can set you free. I turn around once more and savor the silence. □

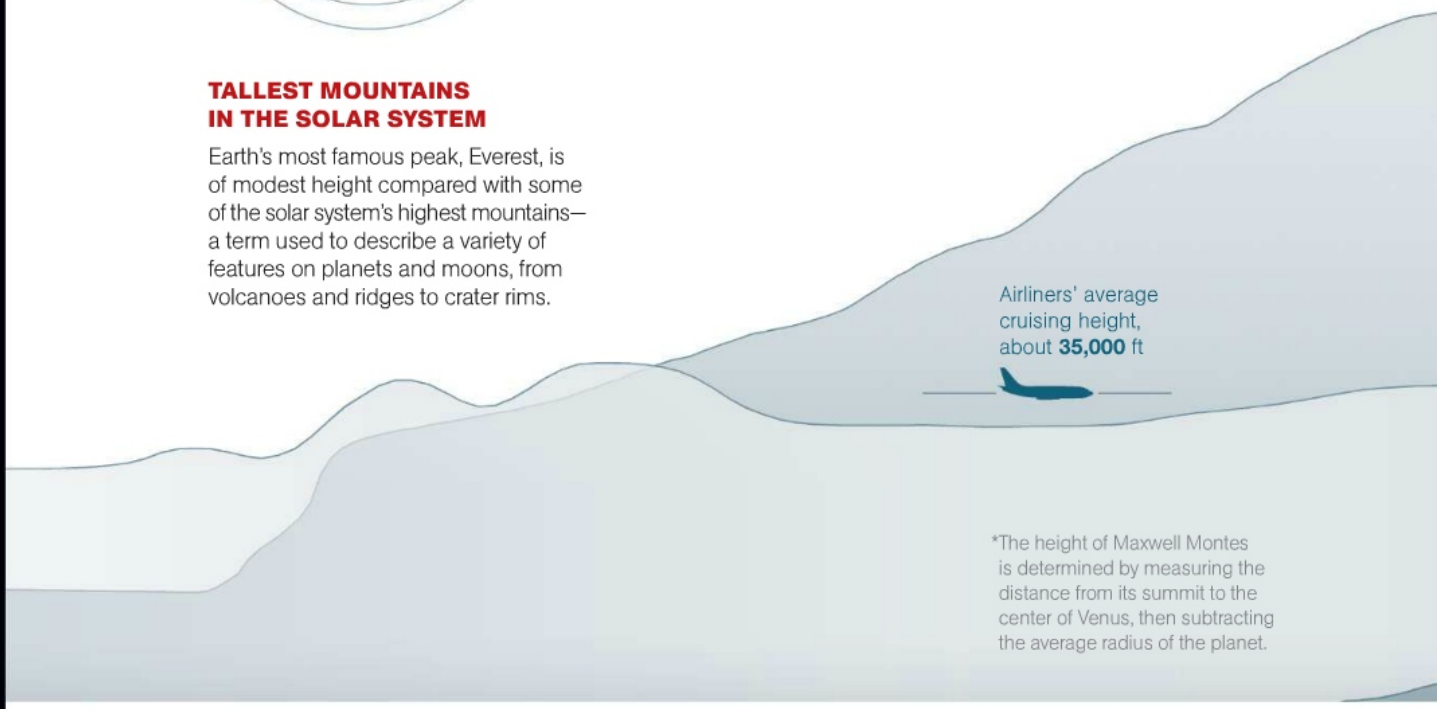
Below the empty horizon the team crunches over blue glacial ice that may be thousands of years old. "It was like walking on a frozen ocean," says photographer Cory Richards.





TALLEST MOUNTAINS IN THE SOLAR SYSTEM

Earth's most famous peak, Everest, is of modest height compared with some of the solar system's highest mountains—a term used to describe a variety of features on planets and moons, from volcanoes and ridges to crater rims.

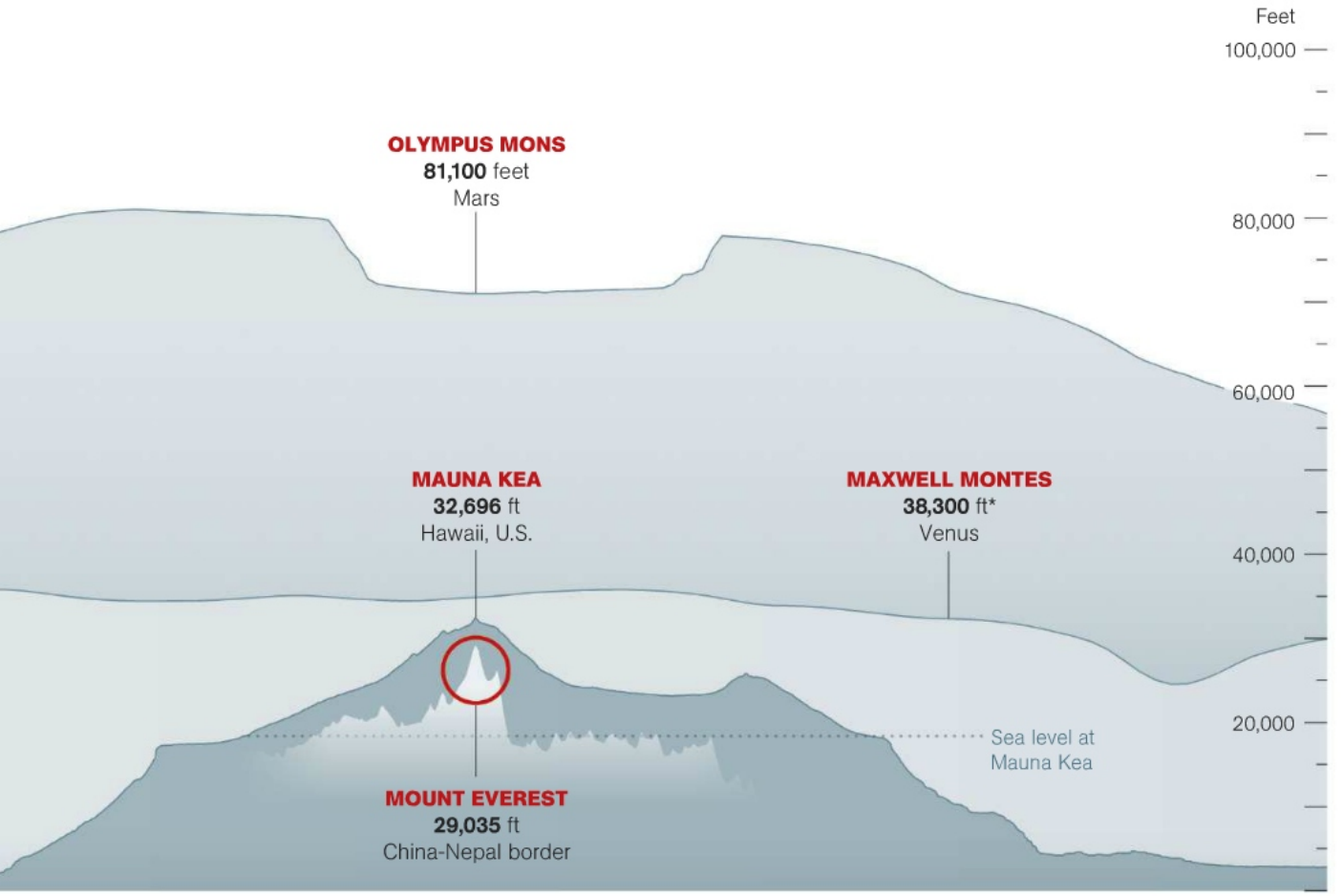


Space Mountains

UNTIL GALILEO CAME ALONG in the early 1600s, people thought the moon was an unblemished sphere. His crude telescope revealed shifting shadows, which the astronomer correctly interpreted as mountains, craters, and valleys.

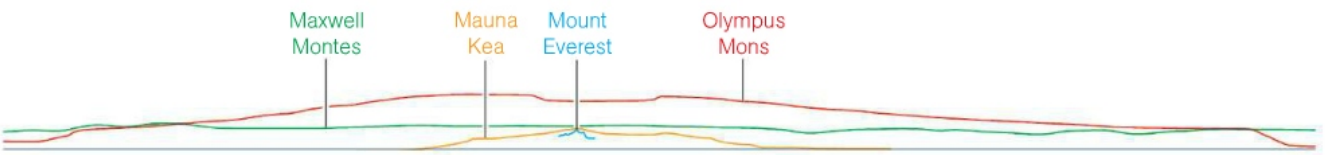
As it turns out, mountains appear all over the solar system. Spacecraft orbiting the inner planets have sent back images and bounced laser beams and radar waves off their surfaces to measure heights. In the early 1970s Apollo astronauts even sampled rock on lunar highlands. Unmanned missions to the outer planets show giant peaks on the asteroid Vesta and the moons of Jupiter and Saturn (the planets themselves are mostly giant balls of gas).

The origins of extraterrestrial mountains offer clues to the solar system's turbulent history.



Mountains are vertically exaggerated by a factor of four.

ACTUAL PROPORTIONS



Asteroid and comet crashes have created mountainous crater rims. Magma flow, which gives rise to volcanoes on Earth, gets credit as well. Other mountains pose mysteries for scientists to solve: Why do pieces of broken crust jut out 9 to 11 miles high on Jupiter's moon Io?

The tallest known space mountain, Olympus Mons, soars 15.4 miles into the Martian sky, nearly three times as high as Everest. If Earthlings ever try to climb it, they will have to slog across a seemingly flat plain the size of Arizona. Many Martian peaks are shield volcanoes—broad, shallow mounds like Hawaii's Mauna Kea, only much, much bigger. That's because Mars has no drifting continental plates, so volcanoes can sit atop magma hot spots longer than they do on Earth, growing ever taller for billions of years.

—Luna Shyr

5W INFOGRAPHICS; ALEXANDER STEGMAIER, NGM STAFF

SOURCES: PETER FORD, MIT; NASA/JPL/PLANETARY DATA SYSTEM; WASHINGTON UNIVERSITY IN ST. LOUIS; NOAA NATIONAL GEOPHYSICAL DATA CENTER

By Melody Kramer Photograph by Marco Grob

Prince of Prints

JR spent three weeks of the spring in what looked like a food truck, parked in Times Square. But instead of food, the French artist dished out oversize photographs. The subjects, a cross-smattering of New Yorkers, could either take their portraits home or paste them on the streets with JR's preferred tools: a brush and a bucket of wheat paste. For the past 13 years JR—who won't reveal his full name—has been plastering portraits on outdoor surfaces throughout the world, often in places where he risks arrest or deportation and where his photos can take on political meaning. In the Kibera district of Nairobi, Kenya, he made pictures of women's faces and cut their portraits in half. The top halves were pasted on trains, the bottoms on corrugated sheets on a slope leading down from the tracks. When a train passed, the portraits lined up for a split second, and the women, marooned in the margins of life, were momentarily made whole.

You've taken photography to places where it's never been.
For me the beauty is that art can appear anywhere. I love when it appears in places that you would not necessarily expect it to appear. When I see people pasting their portraits in crazy places, when they haven't been to a museum, I like that. That's why photography should go to places like that. Anyone can [see] it. Why not everyone should enjoy it?

How do you pick where you're going next in the world?
All the places, I went there because I saw it in my TV, and then I wanted to see it with my eyes. Every place that I've gone was in response to something that happened in the same year. In Kenya there was a riot. The Middle East, it's all over the news every day.

Have you ever failed?
I went to North Korea and couldn't do something. Sometimes society reminds you that art is not welcome everywhere. I'm not looking to go [against] laws; it's just in the nature of my work that it sometimes goes [against] the laws.

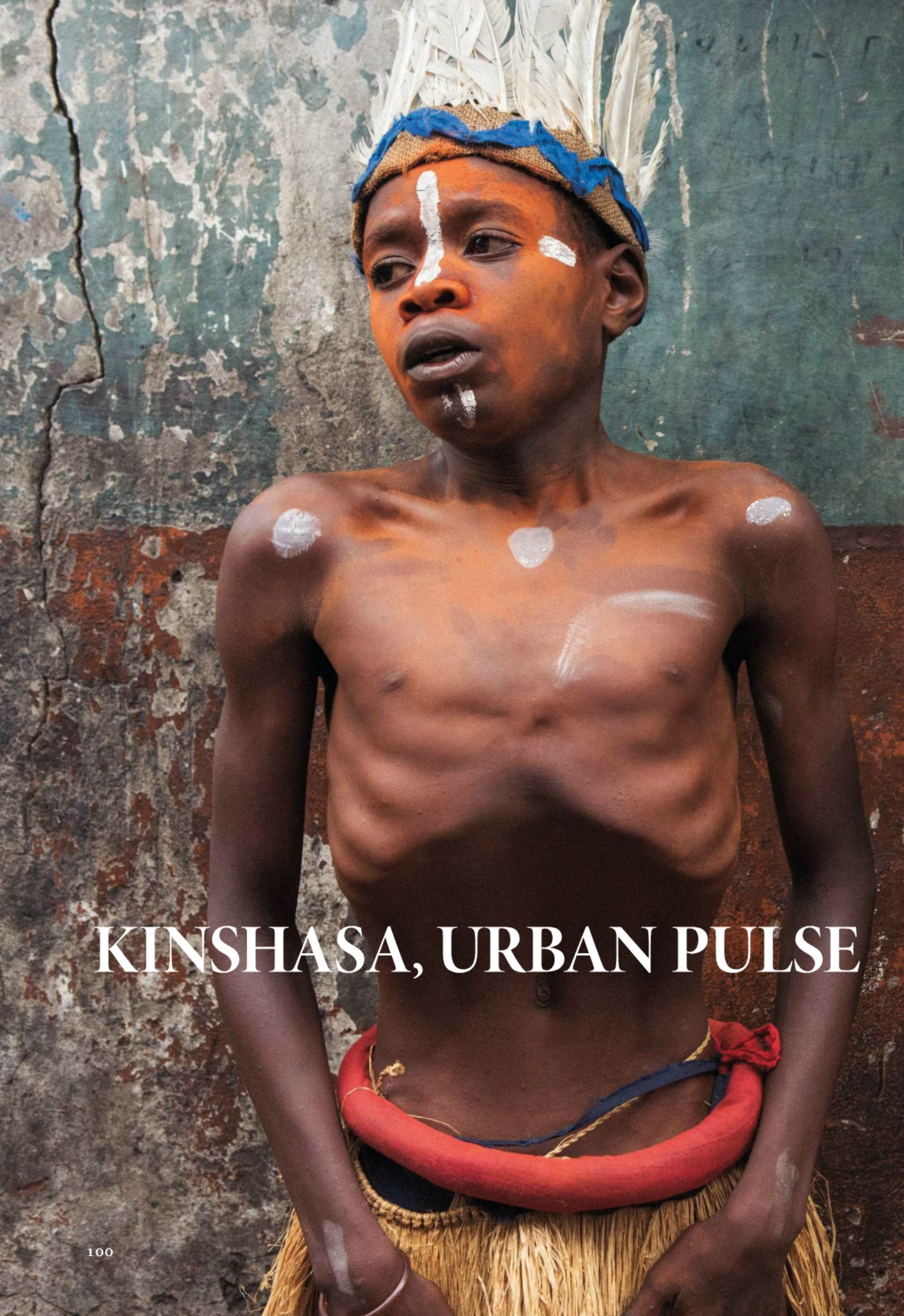
What was it like to go to Cuba?
I realized that the people had never seen a portrait of anyone other than Fidel, Che, or Raúl. They would approach slowly and would be like, "Are these portraits of Fidel or Raúl but from another angle?" And we were like, "No, it's Pablo. He lives right on the corner."

Watch Marco Grob's video interview with JR on our digital editions.

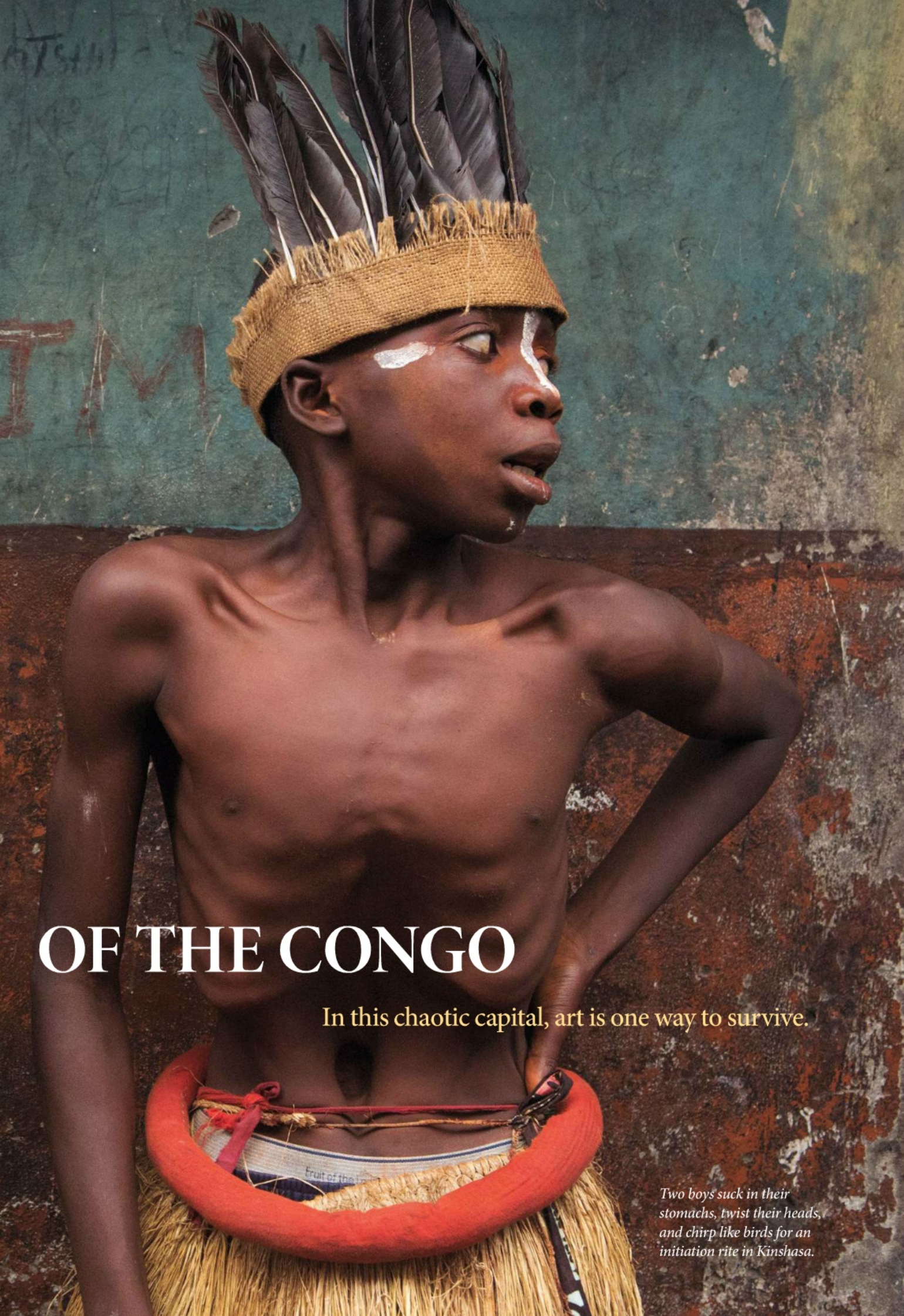


JR STANDS BY AN INSTALLATION IN BROOKLYN. HE COLLABORATED WITH ARTIST DANIEL ARSHAM.





KINSHASA, URBAN PULSE



OF THE CONGO

In this chaotic capital, art is one way to survive.

Two boys suck in their stomachs, twist their heads, and chirp like birds for an initiation rite in Kinshasa.


Soins de visage, manicure, pédicure
BOUTIQUE
Nourrissante et Pleine de Vie!
Vente des Produits de Beauté & Cosmétique
REMISE 3%
MALTINA
MALTINA
BRALIMA
BRALIMA
BRALIMA
Coca-Cola



Kinshasa's busy Ngaba intersection throbs with entrepreneurial energy. Most of the city's residents are officially jobless and must hustle and improvise to survive.





Artist Julie Djikey protests pollution as a "human car," with oil filters on her breasts and motor oil mixed with burned-tire ash smeared on her body.

By Robert Draper
Photographs by Pascal Maitre

Behold the artist.



He emerges from a shed that is no bigger than a jail cell, though it is brightly painted and a sign above its door announces, Place de la Culture et des Arts. The artist lives here, works here. He is 32, with a Mohawk, gold earrings, oversize black-framed glasses, cowboy boots, a Dolce & Gabbana belt, and a flowing copper hooded silk shirt. His name is Dario, and he wishes to inform us, "I am the king of this neighborhood."

The neighborhood in question is Matete: cramped, impoverished, rough, known for its athletes and its thieves. (Not so much for its fashion-conscious artists. Once, in another neighborhood, Dario was mugged and robbed of his fancy clothes, compelling him to take up boxing so he could defend himself.) Beside Dario's shed, an elderly woman sits in the dust and sells piles of charcoal. Up the street sprawls a tangled market where vendors peddle hammers and bananas and cigarettes. Down the street a couple of policemen are attempting to restrain a distraught woman as she rips the clothes from her own body. We are in the quickening heart of Kinshasa, the capital of the Democratic Republic of the Congo—where metrics like per capita nutrition levels and water quality would suggest a near-death state of being. In fact, Kinshasa is all too alive.

"Step inside," offers Dario. There's no bed in the shed. Its walls are covered with Dario's paintings, which are not what you would expect from the prancing and boastful fellow I first met at a *sape* contest, a gathering where male Kinois, as Kinshasa's residents are known, strut the pricey threads they've managed to procure through everyday cunning. From this strange sea of impoverished poseurs, he had lunged out at me, pointing at himself and crowing, "Yohji



Renowned painter Chéri Chérin enlists his apprentice, Mokoko, to hold up a lantern so he can work at night; most of Kinshasa regularly loses electrical power after dark.

Yamamoto pants! El Paso boots! My Kassamoto cap is worth 455 euros!" And so on, until it somehow came out that in addition to being a committed *sapeur,* or fashionista—"When I die, my clothes will be buried with me"—Dario had studied at Kinshasa's Academy of Fine Arts. "I've been painting since I was ten," he told me.

Dario's paintings are irrepressible and dreamy and wistful all at once. They evoke cluttered street scenes and the solitary toil of daily life—a Sisyphean yet exuberant cityscape, one that has produced some of Africa's greatest artists. Many of them—the painters Pierre Bodo and Chéri Samba, musicians Papa Wemba and Koffi Olomide, sculptors Bodys Isek Kingelez and Freddy Tsimba, to name a few—are known around the world. Dario himself may never be. Still, this is his life's commitment, to find beauty in struggle. I ask him to paint something for me, and describe what I have in mind. We agree on a price, which includes a hundred dollars up front for painting supplies. I hand him the cash, which he discreetly tucks into a Bible on his shelf.

"I don't have money," he says. "But people like me are never discouraged. We're fighters. We die with honor."

Behold the city of art. Kinshasa seethes like primordial ooze across a 250-square-mile patch

This is a city of frenzied entrepreneurship, where everyone



of tropics on the south bank of the Congo River. Some ten million live in what the Belgian colonizers once called Léopoldville, and each year another half million join Kinshasa's population. How they will survive is anyone's guess. The city is anything but a breadbasket: Even wheat for bread is imported from overseas, with the result that, according to one veteran Kinshasa-based aid adviser, "You can buy a calorie in America cheaper than they can here. This is one of the most malnourished populations in Africa, if not the world." All of the city's water comes from the Congo River and its tributaries, which is also where all of the city's sewage goes. Only a few of Kinshasa's roads are paved. Its schools are unaffordable for most Kinois. Despite its status as the capital city of the second largest country in all of Africa, Kinshasa is a marvel of dysfunction. Each of the government ministries has to be, as one U.S. official tactfully puts it, "basically self-financing"—meaning much of the money it has is generated by bribery and extortion. This is especially true of the police, who, says the aid adviser, "are one hundred percent on the take. Every one of them is an officer for one reason: to collect for himself."

You would be right to expect anarchy from this collision of burgeoning poverty and state failure. But the West's faith in institutions happens to be irrelevant in this slapdash confluence of metropolis and village. Nor is Kinshasa's story the familiar African tale of woe, oppression, and no way out. Having first gained independence in 1960 from their Belgian colonizers, who left behind no governing capacity to speak of, and having then been deceived and plundered by the dictator Mobutu Sese Seko, the Congolese have long since discarded expectations that their

Writer Robert Draper and photographer Pascal Maitre often report together from Africa. Their next story will take us inland along the Congo River.

RYAN MORRIS, NGM STAFF. SATELLITE IMAGE: RAPIDEYE (MAY 2011)

is a salesman of whatever merchandise comes along.

civil institutions and elected leaders will perform as promised. The miracle of Kinshasa is that it has not discarded hope along the way. On the contrary: This is a city of frenzied entrepreneurship, where everyone is a salesman of whatever merchandise comes along, an uncertified specialist—self-employed, self-styled—a creator amid chaos, an artist in a shed.

I sought out a local author who once wrote of his native city, "Kinshasa is a city where students do not study, workers do not work, ministers do not administrate." The author's name is Lye M. Yoka. He is the general director of the National Institute of the Arts, and he grinned when I read this quote back to him. "The strength of Kinshasa can be found in two places," he told me. "The first is the melting pot: You find a mixture of all the tribes, and there is no friction between local tribes in the capital city." There were wars between military leaders, he said, but "tribal communities have never suffered civil war."

The second source of the city's strength, he went on, is its "great creativity and improvisation. To the outsider the perception is chaos. For me it is not chaos at all. We've developed an informal system. And within this informal system, there's an organization. We use what we have, and we negotiate everything."

Yoka was, of course, describing the very nature of artistic sensibility. "Artists notoriously do not rely on government," he said. "Their artistic activity becomes a way of withstanding their daily crisis, and also a means of dreaming. The bottom line is that passion motivates them to create—and passion has two meanings. It means to suffer, and it means enthusiasm."

This is Kinshasa, city of art, where travail is muse.

I find Freddy Tsimba standing a few feet behind a corrugated metal door, using an oxy-acetylene torch to weld a machete to a sculpture of a pregnant woman made entirely of spoons. Tsimba pays the street children of Kinshasa, the *sheges,* to find discarded spoons in the street and bring them to him. "They don't know what I'm doing here—they just think I'm a crazy guy in the neighborhood who collects spoons," he tells me. "We've got a lot of spoons [in Kinshasa], but unfortunately, nothing for them to eat."

The sculpture, Tsimba explains to me, symbolizes the epidemic of rape in the eastern Congo. "You see the woman has her arm extended out," he says. "She's protecting the children inside. She's fighting the soldier. She's doing her best. The machete, of course, expresses power and violence."

Machetes are all too easy to find in the Congo, I observe.

"Unfortunately, yes. Recently I found many, and the military stopped me, and I told them I was just using them for works of art. I said, 'This is a message to convince people not to kill.' Instead, they arrested me. We argued, and I think I finally convinced them, because they let me go. The government knows I'm a committed artist. The work I do doesn't help the country's image. If anything, it shows the government's weakness."

"Do people ever ask you why you don't focus on more positive images?"

Laughing, Tsimba says, "The older artists—the ones who paint women with big butts dancing and people drinking—don't approve. But the majority of Congolese are suffering, and that's what I represent. I don't wish to flatter the authorities. I prefer to focus on what's real."

The lithe and charming man with the Rastafarian mane ushers me down the dusty roads of Matonge, the neighborhood where he has lived for all of his 45 years. A few dusty sheges follow to see what the crazy spoon collector with the white guy is up to. We pass by a wide creek bed brimming with garbage. Tsimba stops at a metal door, unlocks it, and takes me inside his warehouse. Inside are perhaps 50 other sculptures: some pregnant, many with their legs spread and their hands against the wall. An underworld of gleaming victims made out of spoons, machetes, and bullets.

"I met an eastern Congo woman here in 1998, a pregnant rape victim," Tsimba tells me. "I asked her if she would keep the kid. She said, 'Yes, he's innocent.' This became my inspiration. I showed her the sculpture when I was done. She



All the city's a catwalk for Kinshasa's young sapeurs—*fashionistas who here parade the Matonge neighborhood wearing haute couture. Fierce in self-expression, some spend most of their earnings on designer apparel.*


ZINA
RESTAURANT
ALE ZINA



Villagers who've fled the war-torn countryside have adapted traditional ethnic rituals to Kinshasa's big-city vibe. The Kpou Ambitiri dance group, including dwarfs, perform at tribal ceremonies but also at festivals for money.



Communing with the spirits is a source

was excited, even delighted, that someone was telling this to the world. She said, 'Yes, this is how I suffered.' I sold the sculpture and used the money to pay for the hospital and for clothes, so that she and her baby could go back to Goma."

Since that time, Freddy Tsimba's sculptures have been exhibited across Africa and Europe, in China, in Washington, D.C. He was recently given an artist's residency by the authorities in Strasbourg, where he erected a 20-foot-tall structure memorializing Alsace's many recent eastern European refugees. The proceeds cover his welding-torch fuel, his warehouse, the spoons, and the discarded weaponry.

In other countries an artist of Tsimba's searing humanity would garner fellowship after grant after honorary professorship. Mobutu, for all his kleptocracy, was highly supportive of Kinshasa's artists, especially those who propagandized on his behalf. But the dictator's successors, Laurent Kabila (who overthrew Mobutu in 1997) and Joseph Kabila (who replaced his father after his assassination in 2001), have offered only indifference. The purpose of the government's art ministry is a source of ongoing puzzlement. Kinshasa's two arts schools are in great part funded by tuition from the students' parents. "There's a lack of vision on the part of the government," says Joseph Ibongo Gilungula, the director of the National Museums of Congo in Kinshasa. With a despairing laugh, he refers to the museum of which he is custodian: "How else do you explain the fact that here we have 40,000 pieces of fine art just locked up in a warehouse?"

And so to become an artist like Tsimba, you do what any Kinois would do. You accept that your government is there only to take, not to give. You improvise. You throw yourself into the pursuit of art with such conviction that your parents are persuaded to send you to the Academy of Fine Arts (where you later meet a persistent kid named Dario, who shows promise with a paintbrush). You learn the craft of welding by hanging out with metal artisans who've surreptitiously taken up residency in a former auto parts factory that went bankrupt. You find



of devilry but also of strength.



A street child named Gaby is covered in talcum powder as part of an exorcism meant to drive away demons. Since the arrival of Pentecostal churches in the 1990s, families have begun casting out children they believe are sorcerers—a superstition that also reflects economic desperation.

A drummer batters away at his

your material and your inspiration from the streets. What money you make, you make from wealthy clients outside the Congo. You live each day by your wits, by self-reliance, in a turbulent mélange of urban Darwinism and tribal provincialism where the kind of artistic risks taken by a Freddy Tsimba may invite misinterpretation. "The work I'm doing, some people connect it to evil," he acknowledges. "They think my art is devil-like. My own relatives think I'm a witch. I don't eat with my extended family anymore, because I'm afraid they'll try to poison me."

Communing with the spirits, to the Kinois, is a source of devilry but also of strength—the elixir stirring their shadow economy, the wild card on which a struggling soul's luck can turn at a moment's notice. I've read this many times, that Kinois believe that the spirits of the dead can alter one's life. I feel it for the first time one night in the Matonge neighborhood, the stronghold of Kinshasa's music scene.

The internationally renowned rumba star Papa Wemba, who hails from Matonge, is properly swarmed by the locals whenever he returns in his natty suit with a fat cigar jutting from his mouth. At night the streets of Matonge erupt with disembodied melodies and ecstatic clubgoers. Passing by the cramped little venues, you hear a torrent of drumbeats, rocketing harmonies—and, of course, the languid sensuality of rumba, which made its improbable journey to Kinshasa from Cuba in the 1930s and '40s via West African sailors and Caribbean laborers and records sold by European merchants, and was instantly seized upon by the colonized Kinois as a rhythm after their own heart.

One evening I meet Tsimba at a Matonge club called La Porte Rouge to see the house band, Basokin. The club is a garage, illuminated by a string of four dangling lightbulbs, with a car parked inside, leaving only enough room for a makeshift stage and a half dozen plastic tables. Vendors shuffle in to sell Congolese beer, grilled beef brochettes, and cups of peanuts whose shells litter the concrete floor. The band members, all male, file onstage: three vocalists, two electric guitarists, one bass guitarist, three tom-tom players, and a percussionist who diligently raps a drumstick against an empty beer bottle throughout the performance. Through a grungy and reverb-heavy sound system, the music commences at a slow trot with soft drumbeats and a loopy guitar riff. The lead singer, a middle-aged man in a faux-silk shirt who calls himself Mi Amor, bellows out a few syllables. Then the other two vocalists punch their way in—a distinctly guttural and polyphonic harmony from the Songye ethnic group, from which the band's name originates. The song ambles on: the singer forcefully sermonizing, the drumbeats gaining power, the guitar loop corkscrewing ever tighter, an almost imperceptible building of intensity. So it goes for eight minutes until, from somewhere behind the parked car, dancers materialize and head slowly toward the stage.

There are four of them, all women, all young, all barefoot. Tonight they are dressed in simple skirts and tank tops; later that week, when I return to La Porte Rouge with the crazed fervor of a celebrity stalker, they are clad in brilliant yellow-and-red tribal dresses. The singers have now receded into a chanting and grunting support role, while the dancers whirl, swirling into the swirling whirl of a guitar improvisation that has assumed a mad wall-of-sound gallop. Heeding the locomotion of the drums, the young women stand before the audience and proceed to simulate a rhythmic hybrid of sex and childbirth: from the waist down, laboring in unfathomable motion; from the neck up, utterly trancelike. The audience, Freddy Tsimba and myself included, is locked in what feels like a state of shared hallucination.

One of the percussionists begins to beat on a tall instrument that, I later learn, is called an *etumba,* a drum that emits a bell-like tone. Another drummer leaps to the front of the stage and batters away at his tom-tom with Keith Moon-like fury while blowing on a whistle. The two backup singers maintain a stuttering chant over Mi Amor's gusting vocals. The dancers grind on, slick with sweat. The young woman in the center has her eyes closed, her mouth slack

tom-tom with Keith Moon-like fury.

with surrender, her hands extended in offering.

And then, suddenly, the lights go out and the guitars fall silent. The generator providing the electricity for La Porte Rouge has sucked up its last drop of gas. Basokin disappears into darkness, while someone grabs a plastic container and runs down the street to fetch more fuel. A half hour later the nightclub is alight, the band returns to the stage with stoic composure, and a new 20-minute spiral of sound and motion fills the garage and, I find myself believing, the city beyond.

A few days later I meet the singer Mi Amor for a beer in Matonge. The streets are tame in the sunlight, and the band leader is, like Freddy Tsimba, both amiable and gravely earnest about his art. He tells me that Basokin has performed together for 30 years. Two of the dancers are daughters of the musicians. Since 1987 Basokin has played at La Porte Rouge every Monday, Wednesday, and Friday. Mi Amor and one of the other members have government jobs; the rest, he explained to me, "work in the informal structure," which is to say that like the vast majority of Kinois, they scrape by however they can, including on tips from the audience.

The pressure to survive as an artist in Kinshasa has compelled even famous musicians like Papa Wemba to accept corporate sponsors and insert commercial jingles into their repertoire. (In the case of Papa Wemba: "Drink Mützig beer!") Basokin has resisted such impulses. "The band members are all from the tribes that represent Songye culture, and what we try to do is preserve basic folk traditions," Mi Amor tells me. "Folk songs are static, not dynamic. We replace a few words, and we replace a traditional instrument like the xylophone with a modern one like the guitar. But our songs talk about returning to the traditional values that we're losing. For example, one of the songs you heard us play talks about a poor man, and how you shouldn't mock him for his poverty, because you can never tell where he'll be tomorrow. We are all granted wealth, each person in his own time."

The music itself, the singer tells me, is intended to evoke the supernatural—the bedrock of Songye spirituality, replete with sorcery and veneration of the dead. "When the dancers join in, and we're improvising, it's a mix of forces," he says. "We're addressing ourselves to the deceased Songye elders. It's as if we're back in our villages, talking to the people in the world of the dead, and they're listening."

A Belgian music producer and manager, Michel Winter, has been to Kinshasa numerous times and plucked from obscurity remarkable acts such as Konono No. 1 (a band that employs in its music an electronic version of the traditional thumb piano known as the *likembe*) and Staff Benda Bilili (a group featuring several paraplegic street singers that became an international sensation and that spawned an engaging offshoot band of physically challenged musicians called Handi-Folk). Winter discovered Basokin back in 2002 and has since toured the band throughout Europe. "For me, Basokin is just incredible, hypnotic," Winter says. "They make no money, and they show a lot of courage playing three times a week. Kinshasa is full of crazy dreamers like Basokin and Staff—rehearsing and rehearsing day after day. I think there is no other place on Earth like that."

The problem, says Winter, is how to convey to a wider audience the primal intensity Freddy Tsimba and I witnessed at La Porte Rouge. "I don't know how you can reproduce the impact you feel when you're there on a clean and pure recording system," he sighs. "I don't know the solution. I just know that we need to get them on a recording before it's too late."

It is possible to overly rhapsodize the city's magic—to conjure up Kinshasa, as Yoka does, as "sexy and unpredictable, like a woman," as a landscape of "breakers of stones and artists of struggle, who confront misfortune with a smile, taking it in their own style—that is, with humor and satire." But the author admits that the "informal system" is far from an ideal one. "I'm not apologizing for our city," he says. "We're in the modern era, and there are modern standards we need to adapt to."

Because the raw and rich tableau of Kinshasa's compulsive entrepreneurship can quickly

darken. These things happened to me and could just as easily happen to you: You will be in an SUV driving through Matonge, and suddenly a man will jump onto the running board of your car. He will bang on the window. He will say that your car sideswiped his and that he demands immediate compensation. Your guide will deny this and accelerate the vehicle. The man will hang on, mile after mile, until a traffic cop witnesses the situation and signals for you to pull over—and will also demand money. If your guide does not happen to have the cell number of the chief of police, as ours did, then you will spend the next several hours in a state of detention until you agree to cough up sufficient money to ensure your freedom.

Or: You are driving at dusk to the outlying neighborhood of Ndjili to see a band. The pavement has given out to badly pocked dirt thoroughfares. Then all traffic stops. Somebody's car has stalled. And now every vehicle turns sideways, trying to find a way out, thereby sealing any way out, and all sense of order disintegrates into a pulsing, unpoliced hell. Passengers leak out of the dingy commuter buses and swarm the roads. Mothers cradling infants. Dogs. Bodies and dust engulf all light. Horns blast. Men shout and pound their fists against cars like yours. You are swallowed up by the ten million and growing, and there is no escape.

Somehow you do escape, because you're lucky and can afford a skilled driver. You're not one of the tens of thousands of street children, many thrown out by parents who decided that their ill luck as Kinois must be due to the presence of witchcraft in the household. "In traditional societies, whenever a kid loses his parents, automatically he's taken in by others in the extended family," says Henry Bundjoko Banyata, a Kinshasa-based art history professor who as a 12-year-old boy in his rural birthplace was ritually initiated to practice tribal medicine—what we think of as a healer. "But ever since the economic meltdown of Kinshasa which began under Mobutu, some families, due to lack of means, got rid of their kids. Or the families joined a church for protection against evil forces, and the pastor at the church confirmed that these kids were sorcerers. In the village you don't find such practices. It's like respect for elders and for the environment—they're neglected here as well. In the city we've lost such values."

Behold the city reimagined. Its gateway is a multicolored wheel. Beyond the wheel stretches a ribbonlike boulevard that crosses a Garden of Eden and concludes at a metropolis jutting out of a large body of water. The skyscrapers are bright and fantastically proportioned, a cross between Dubai and Legoland. Some of the buildings bear the emblem of a commercial product like toothpaste or beer; others, a place: Libya, U.S.A., Himalaya. The city is spotless, fiercely original. Also completely uninhabited.

The creator of the intricate cardboard-and-Plexiglas model city is Bodys Isek Kingelez. He looms over it, a bantamlike, middle-aged Kinois dressed entirely in red, from his sunglasses to his leather shoes. "Why don't we build on water? There's lots of space! It's because we are afraid," the artist declares. "Architects and builders worldwide can try to learn from my perception so as to help the forthcoming generations. I'm dreaming cities of peace. As a self-made intellectual, I haven't yet reached the point I wish to reach. I'd like to help the Earth above all. Voilà."

To be in the presence of the reclusive artist and his carnival-like models is to understand that he is not really compelled by altruism. Instead, he embodies the human audacity to reorder and wholly reinvent. To be God, as Kingelez himself observes: "When God created the world, it was Solomon who created the first great buildings. Today I'm just following God's creation. I never sketch first. Academicians draw. I'm a creator. I rely on my vision."

The vision came to him, the artist says, in 1979, while he was teaching economics in Kinshasa. "I had a revelation—it was like I was ill," he recalls. "The voice said, 'You have much to do. Find scissors, glue, and paper.' I asked, 'What can I do with these?' The spirit told me, 'Simply begin. You will see.' I stayed at home with nothing to eat. The small model was finished in two

No obstacle is too great for some Kinois musicians. The popular band Handi-Folk—made up of polio-afflicted paraplegics and other disabled players—rehearse at a bar. Bruce Makanga (below) began studying the violin in his modest home and has played in the city's Kimbanguiste Symphony Orchestra for four years.



At the Lebanese-owned Pain Victoire bakery, baguettes called kanga journée *are everywhere. First introduced by the colonial Belgians, bread has recently become ingrained in the Kinois diet because it is cheap.*


JANGAARD

Freddy Tsimba welds spoons and bullets into politically charged sculptures, like this depiction of a pregnant woman with a suitcase of empty water bottles. The reclusive Bodys Isek Kingelez (below), whose futuristic model cities fetch tens of thousands of dollars, stores his work inside a car within his walled compound.

weeks. Someone from my family came to visit and saw it. He said, 'You must sell it!'"

He has been exhibiting and selling his models across Europe and the U.S. ever since. Today the great Kingelez lives in a walled compound, though he claims to own 30 houses scattered throughout the city. He keeps five cars in his garage; two of them serve as storage for his deconstructed models. His house is small, and one room is devoted to the $30,000 worth of Plexiglas and other art supplies he has imported from Europe. The house is otherwise filled with dozens of suitcases containing his multitude of clothes. "I wear the same clothes only once every six months," he explains. "The shirt, jacket, and shoes need to be harmonious. For me, being well dressed is part of the human power. Sometimes my wife feels like we're suffocating with all these suitcases. Women are weak creatures. The logic I was born with is sometimes difficult for others. Even my children stay inside the compound and don't go out. The people around here say, 'Why are they living like white people, never going out into the streets?' But Europeans who visit, they feel at home here in my compound. They tell me, 'You're as white as we are.'"

He is a fervid admirer of the U.S. "The American President, the first thing he does is put his hand on the Bible, and his first pledge is 'so help me God,' not 'so help me man.'" Kingelez notes. "This is why Americans are unique. They will never be stopped, in the way a river can never be stopped. I'd like to finish my life there, to make America stronger still." Correspondingly, Kingelez is appalled by Kinshasa, the city he lives in but had no part in constructing. "It's a city full of musicians who chase the ladies but don't do anything for the benefit of society," he says. "This is why the Congo will stay poor. I deeply detest all this noise, this music. You can't think about the future when this loud music is playing. If you spend all night shouting and jumping and dancing, in the morning you won't be able to do anything of value."

Kingelez's low regard for the decadence of Kinshasa is no doubt exacerbated by the city's disregard of him. "Here in Kinshasa, I've never done any exhibition," he observes. "Let me tell you, no one knows who I am or what I do. Two weeks ago I was very sick, and I was about to die in front of my wife. No one in Kinshasa would have known. Nothing on the radio or TV or the newspapers. That's the way it goes in the Congo."

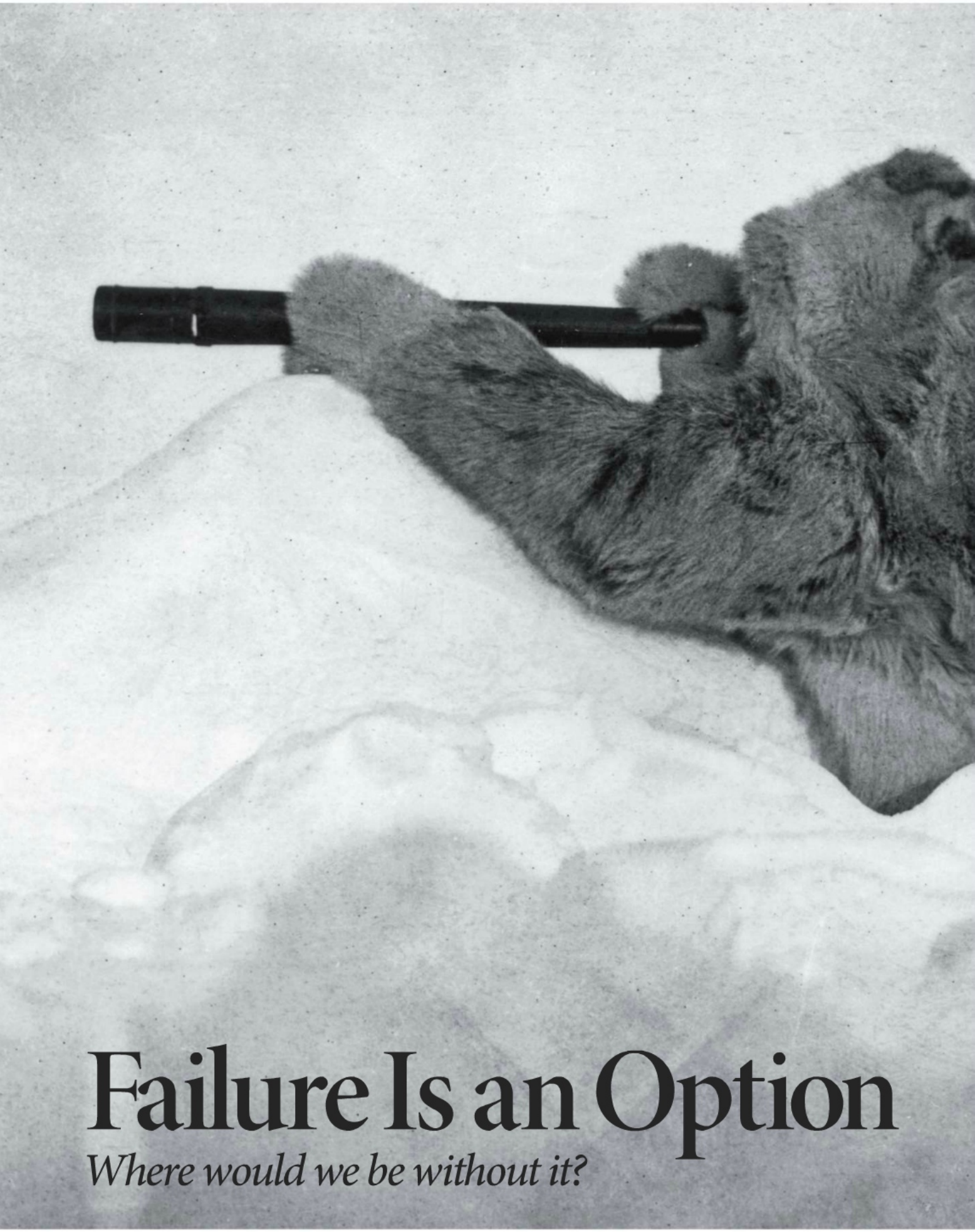
Behind his imperial scowl, an ample ego bleeds a little. Still, Bodys Isek Kingelez has it wrong. He is not a displaced American. He is not distinct from his city. He is, if anything, quintessentially Kinois—and indeed the city's culmination: An African Picasso of such brazen optimism that he needs no one, nothing, only his inhuman determination along with the human detritus of paper and plastic to construct his heaven on Earth, his model kingdom. He is King! He is Kingelez! He is Kinshasa!

Inside his artist's shed, Dario holds up the painting I've commissioned. It is a wood-framed portrait of my dog, Bill—a creditable rendition (including the one ice-blue eye), with some unusual flourishes: Bill appears to be standing on the banks of the Congo River, and seashells are glued to the surface of the water.

"I painted it at nights, when I was alone," Dario says. "That's when God provides inspiration to artists. He lays his divine hand on us at night."

I pay him the balance, but Dario is not through with me yet. Another surprise awaits, and he leads me there, sashaying in his cowboy boots down the gritty, sweltering catwalk of the Matete market, with children once again falling in behind the self-anointed king of the neighborhood. He comes to a halt at a metal door, knocks. A large Congolese woman wearing gold hoop earrings and an NYPD cap lets us in. Now we're on a verdant little patio. Two acoustic guitarists and two drummers are in mid-song. Dario, it turns out, is also a musician, and this is his band.

"I dedicate this song to the Congo," he announces to the patio, "where there is war and suffering and starvation. My country." And as the music churns, Dario proceeds to chant, "Africa is a sun pointed upside down"—the artist uninhibited, undaunted, and for all we know, unstoppable. □



Failure Is an Option

Where would we be without it?



ADMIRAL ROBERT E. PEARY

"Find a way or make one," said the explorer, peering over Arctic ice on his third try to reach the North Pole, in 1909. He said he succeeded that year—a claim disputed by some.

ROBERT E. PEARY, NATIONAL GEOGRAPHIC CREATIVE

By Hannah Bloch

At the end of the 19th century

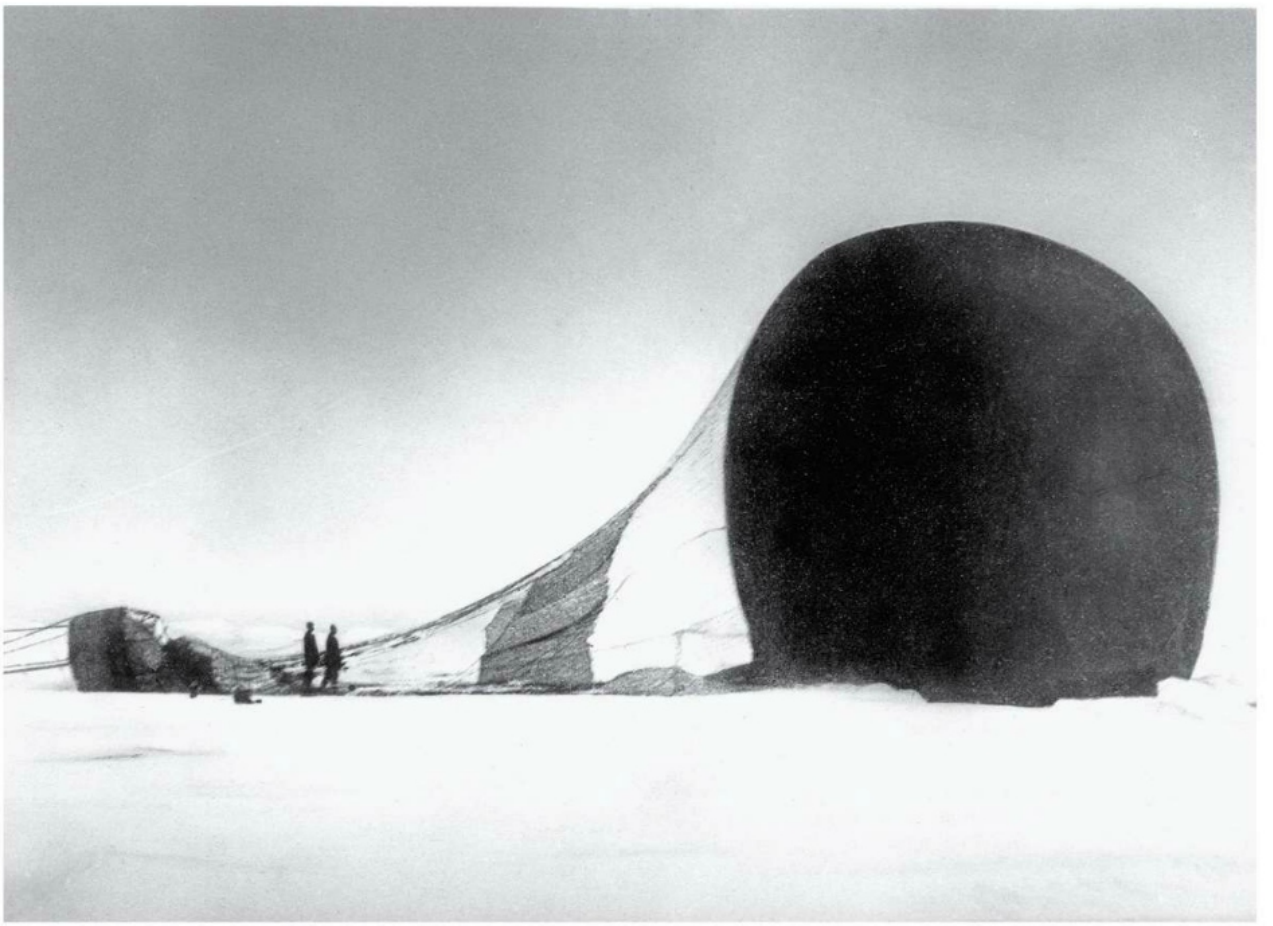
a middle-aged Swedish engineer, a patent officer captivated by the promise and possibilities of technology, came up with a radical idea: Why not fly in a hydrogen balloon to become the first to discover the North Pole, then as mysterious and unknown as Mars? For years explorers had attempted to reach the Pole overland; many died trying. An air expedition, Salomon August Andrée reasoned, would eliminate much of the risk. And so, on a windy day in July 1897, with support from Alfred Nobel and Sweden's king, Andrée and two younger colleagues climbed into the basket of a 67-foot-diameter balloon on Danes Island in the Svalbard archipelago. The team packed wooden sledges, food for several months, carrier pigeons to relay messages, even a tuxedo Andrée hoped to wear at the end of the journey. As journalists and well-wishers cheered and waved, they soared into the air, aiming to float to a place no human had seen.

As soon as they lifted off, wind battered the balloon. Fog froze on it, weighing it down. For 65 and a half hours the *Eagle* skittered along, sometimes grazing the Arctic Ocean. Thirty-three years later, sealers stumbled across the frozen corpses of Andrée and his crew—along with their cameras and diaries, which revealed that they'd been forced to land on pack ice 298 miles from the North Pole. The three had perished during a grueling three-month trek south.

Failure—never sought, always dreaded, impossible to ignore—is the specter that hovers over every attempt at exploration. Yet without the sting of failure to spur us to reassess and rethink, progress would be impossible. ("Try again. Fail again," wrote Samuel Beckett. "Fail better.") Today there is growing recognition of the importance of failure. Educators ponder how to make kids more comfortable with it. Business schools teach its lessons. Psychologists study how we cope with it, usually with an eye toward improving the chance of success. Indeed, the very word "success" is derived from the Latin *succedere,* "to come after"—and what it comes after, yes, is failure. One cannot exist without the other. Oceanographer Robert Ballard, a veteran of 130 undersea expeditions and discoverer of the *Titanic,* calls this interplay the yin yang of success and failure.

Even at their most miserable, failures provide information to help us do things differently next time. "I learned how *not* to climb the first four times I tried to summit Everest," says alpinist Pete Athans, who's reached the world's highest peak seven times. "Failure gives you a chance to refine your approach. You're taking risks more and more intelligently." In his case this meant streamlining his team and choosing less challenging routes for his first successful ascent, in 1990.

Failure is also a reminder that luck plays a role in any endeavor. Climber Alan Hinkes, a member of the small club of mountaineers who've summited the world's highest peaks, has had his share of misfortunes: broken his arm, impaled



his leg on a tree branch "like a medieval spear," sneezed so violently near the top of Pakistan's 26,660-foot Nanga Parbat that he slipped a disk and had to abort the climb. "I probably should be dead," he admits. But "I haven't had any failures. I have had near misses and close shaves."

For most explorers, only one failure really matters: not coming back alive. For the rest of us, such tragic ends can capture the imagination more than success. Robert Falcon Scott, who died with his team after reaching the South Pole in 1912, is hailed as a hero in Britain. Australians are moved by a disastrous 19th-century south-to-north expedition that ended in death for its team leaders. These tales stick with us for the same reason our own failures do: "We remember our failures because we're still analyzing them," Ballard says. Success, on the other hand, "is quickly passed." And too much success can lead to overconfidence—which in turn can lead to failure. During the 1996 Everest season, in which 12 climbers perished, mountaineering experts wrongly "felt they had the mountain wired and pretty well sorted out," says Athans, who helped head up rescue operations. "In truth, the formulas get you into trouble." Failure keeps you on your toes.

Scientific researchers are reluctant to own up publicly to flops. Reputations and future funding depend on perceptions of success. But in the past decade, at least half a dozen journals—mostly in medicine and conservation—have solicited reports of failed experiments, studies, and clinical trials. The rationale: "Negative" results

NORTH POLE BALLOON EXPEDITION *Members of S. A. Andrée's 1897 journey surveyed their downed vessel before embarking on what would be a fatal three-month slog south. This photo was recovered from a camera when their remains were found 33 years later.*

GRENNA MUSEUM, ANDRÉEXPEDITIONEN POLARCENTER/SWEDISH SOCIETY FOR ANTHROPOLOGY AND GEOGRAPHY





GEORGE MALLORY
No one had reached the summit of Everest when Mallory (standing second from left) joined a 1924 team. They posed at base camp days before Mallory vanished during his attempt.

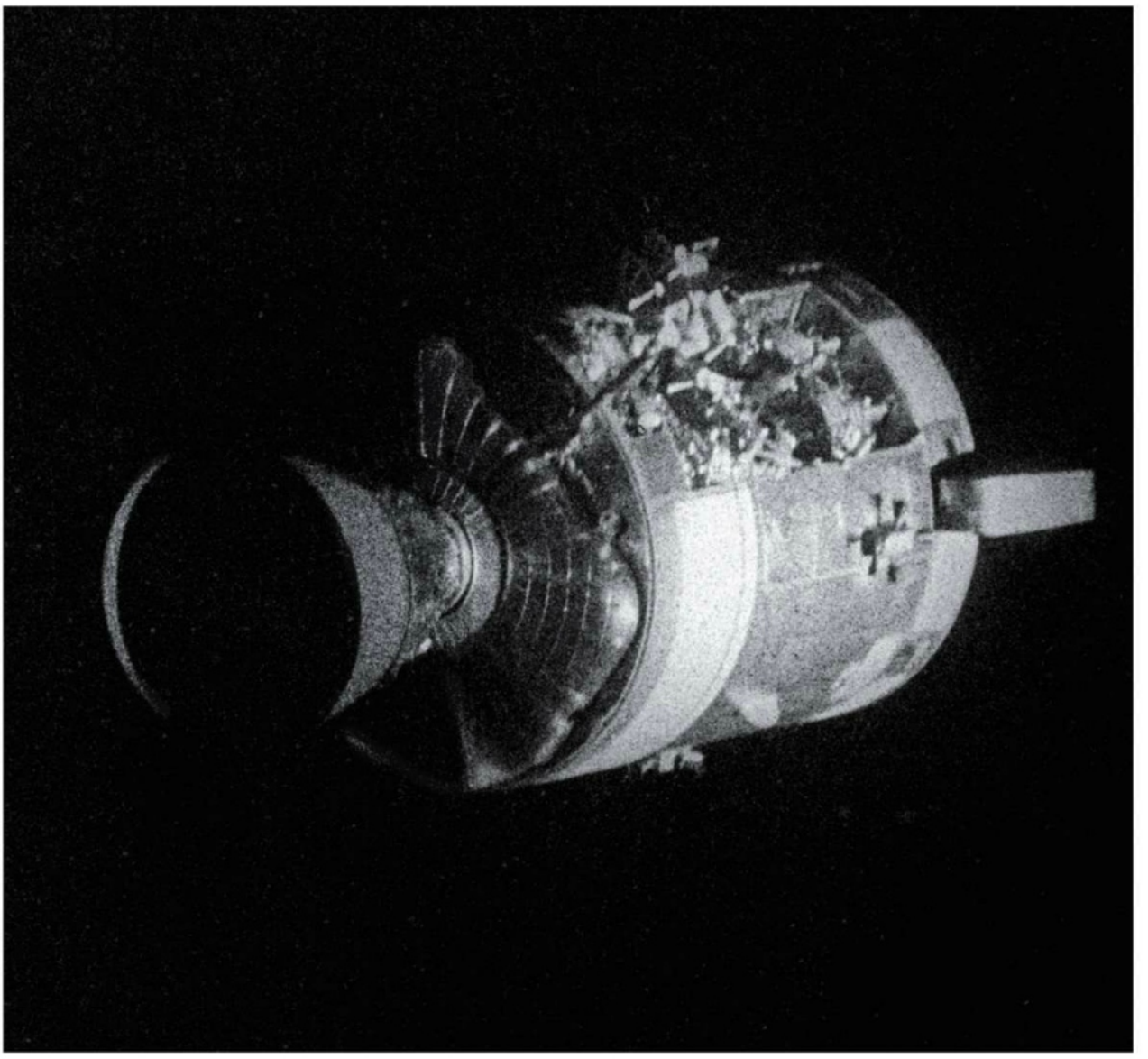
OTTO LILIENTHAL
A 19th-century German engineer who inspired the Wright brothers, Lilienthal pioneered glider flight. In 1896 a photographer captured him aloft days before he died after a flight accident.

J. B. NOEL, ROYAL GEOGRAPHIC SOCIETY, WITH IBG (TOP); R. W. WOOD, NATIONAL GEOGRAPHIC CREATIVE



AMELIA EARHART
The aviatrix vanished in 1937 during an attempt to fly around the world along the Equator. When women fail, she said, "their failure must be but a challenge to others."

APOLLO 13
The 1970 moon mission was a failure, aborted after an oxygen tank in the service module (below) exploded. But it was a success as well: The astronauts came back alive.



HULTON-DEUTSCH COLLECTION/CORBIS (TOP); UNIVERSAL IMAGES GROUP LIMITED/ALAMY

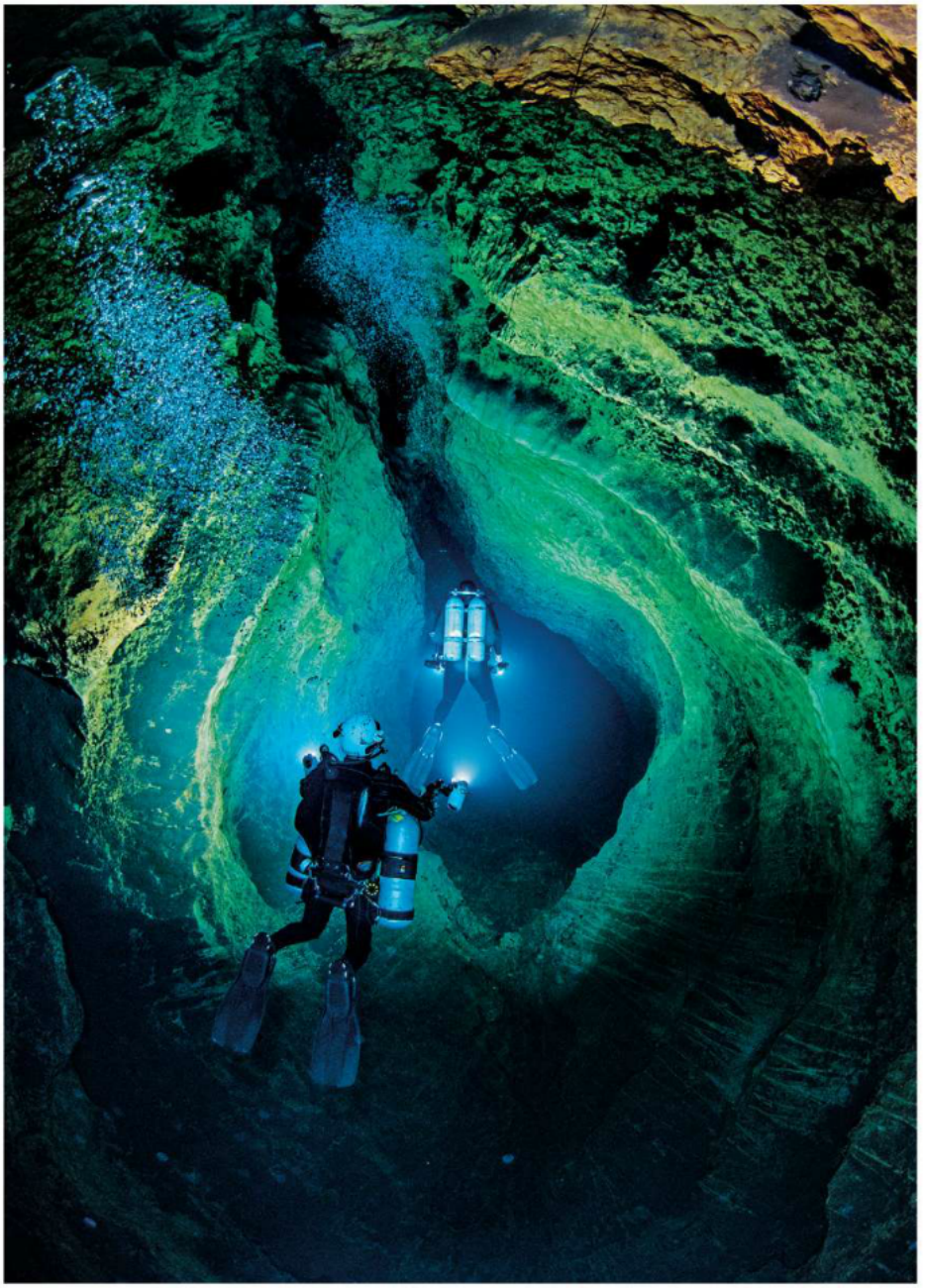




ERNEST SHACKLETON EXPEDITION

"I have marveled often at the thin line that divides success from failure," Shackleton wrote after his doomed 1914-16 trans-Antarctic journey. His team had to abandon their ship when it became stuck in the ice. After a nearly two-year trek to safety, all 28 returned to the U.K. The dogs were not so lucky.

UNDERWOOD & UNDERWOOD/CORBIS



UNDERWATER CAVES
Deep, dark, and hard to navigate, they attract the bravest of explorers and yet give them pause. Prudence can outweigh the lure of potential success. Assessing this cave in Florida, divers Kenny Broad (at left) and Tom Morris have agreed, for now, to leave it "relatively unexplored."

MARK LONG

can eventually give rise to positive outcomes.

The business world, especially the high-tech realm with its rapid-fire start-ups and burnouts, already understands the value of negative results, if they are low-cost and noncatastrophic. To encourage entrepreneurship, the Netherlands-based ABN AMRO Bank started an Institute of Brilliant Failures. Eli Lilly and Company, the pharmaceutical giant, began throwing "R&D-focused outcome celebrations"—failure parties—two decades ago to honor data gleaned from trials for drugs that didn't work. (Some 90 percent of all such trials fail.) Some foundations have even begun requiring grantees to report failures as well as successes.

Business leaders often seek nuts-and-bolts lessons from failures, but they benefit from bigger-picture truths as well. A Harvard Business School professor was so struck by an iconic, century-old exploration failure that she authored a case study about it—to teach her M.B.A. students about leadership. Historian Nancy Koehn reckons she's taught the story of Irish-born polar explorer Ernest Shackleton at least a hundred times. His 1914-16 expedition to cross Antarctica was doomed when his ship, the *Endurance,* became trapped in the ice. Shackleton's goal quickly shifted from exploration to ensuring a safe return home for himself and his crew.

Hannah Bloch wrote about Easter Island archaeology in the July 2012 issue.

"It's a huge failure from the perspective of exploration, right?" Koehn says. "But it's inspiring partly because it's a failure. We're in an age of corporate malfeasance and companies being called to account and saying, It's not my fault. But he said, By God, I'm going to clean it up. He owned responsibility for the mess." Shackleton brought the 27 men on his team safely home. "He was a great crisis manager," says Koehn. Through him, her students "learn about persistence and resilience, and a lot about small gestures." Shackleton made sure to give all of his men cups of hot milk if he noticed that even one was flagging.

Persistence. Resilience. Adaptability and crisis management. All are key themes in exploration, as in ordinary life. Keeping things in perspective helps too: Explorers tend to take the long view, recognizing the illusory nature of failure and success. "Treat those two impostors just the same," Kipling advised in his poem *If*. "That's how I feel about it," says cave explorer Kenny Broad. Many of his colleagues have perished in deep scuba dives in darkness through mazes of caverns. "You can get lucky in a dive. You get lucky a few times and start to think that's skill. Success and failure in cutting-edge exploration is a very fine line."

S. A. Andrée's balloon expedition was cutting-edge for its day, and fail it did, but "you don't know until you try in aviation," Urban Wråkberg, a historian of science at Norway's University of Tromsø, points out. Improved technology ultimately helped solve the problems of Arctic aviation (the first successful flight to the North Pole took place three decades after Andrée's attempt) and has opened countless other doors. Satellite uplinks, reliable communication, and advances in meteorology and robotic assistance are just a few innovations that have pushed the limits of exploration. But even Ballard, whose major discoveries were aided by robots, notes that technology "doesn't make everything possible."

And that's a good thing. "If you take away uncertainty, you take away motivation," says Athans. "Wanting to exceed your grasp is the nature of the human condition. There's no magic to getting where we already know we can get." □

Famous Failures (and some silver linings)

1492
Christopher Columbus
He never did make it to India. But no one held it against him.

1804-06
Lewis and Clark
They sought a water route from the Missouri River to the Pacific. There's no such passageway. They did document the geography, people, plants, and animals of Louisiana Purchase land.

1925
Percy Fawcett
He went into Brazil's rain forest to find the ancient city of Z and disappeared. A few years ago archaeologists discovered a lost civilization called Kuhikugu in the vicinity of Fawcett's expedition.

1940
Tacoma Narrows Bridge
The four-month-old suspension bridge undulated and collapsed in high winds. Wind impact had not been fully weighed during construction. Later designs included lower decks for stability.

1991
Biosphere 2
Locking eight people in a $200 million terrarium didn't go so well: food shortages, bad air, "crazy ants." But Columbia University and the University of Arizona have since used the dome for eco-research.

1993
Apple Newton
Known as Apple's biggest flop, the personal digital assistant expired after six years but paved the way for the iPad.

1998
Mars Climate Orbiter
NASA sent the orbiter to study Martian climate. But after a 287-day journey the probe likely burned up in the red planet's atmosphere. The problem: details, details. NASA used the metric system; the engineering team at Lockheed Martin used English units of measure.

—Brett Line and Linda Poon

NG CONNECT

Every month this page features our staff picks of National Geographic Society products and events. For more go to *nglive.org.*

NATIONAL GEOGRAPHIC ON TV



The Secret Life of Predators

From scorpions in Southeast Asia to sailfish off the coast of Mexico (left, chasing a school of sardines), nature's hunters must constantly adapt to keep their place in the food chain. This month the National Geographic Channel and Nat Geo WILD get closer than ever to the action with unprecedented coverage of some of Earth's toughest fights to the finish.

PLAY

ALEXANDER GRAHAM BELL The life and legacy of Alexander Graham Bell—the Society's second President—set the scene for a new play by PBS's Jim Lehrer. Catch a performance September 12 through 21 in Washington, D.C. For tickets go to *nglive.org/dc.*

FILM



JERUSALEM 3-D Witness Jerusalem like never before. Aerial shots of the region and footage of rarely seen holy sites reveal layers of history in a city where Judaism, Christianity, and Islam intersect. This giant-screen film opens in museum theaters in September. Find screenings at *jerusalemthemovie.com.*

EXHIBIT

ONE CUBIC FOOT This jewel scarab (right) is one of many diverse critters that passed through the metal frame David Liittschwager built to document life inside one cubic foot. Visit *ngmuseum.org* for details on his D.C. exhibit.



ACTIVITY

THE GREAT NATURE PROJECT From September 21 to 29, share your backyard with the world by uploading plant or animal photos, then tagging them with #GreatNature. Get started at *greatnatureproject.org.*

Book of the Month



National Geographic Kids Quiz Whiz 2

Do you know which bird can fly backward? Or how many people visit the Grand Canyon each year? How about where to find the world's highest mountains? Test your smarts with *Kids Quiz Whiz 2.* This compact book is bursting with a thousand fun, surprising questions and answers about animals, pop culture, space, geography, and more. Available now ($9.99).

PHOTOS (FROM TOP): RODRIGO FRISCIONE; NICOLAS RUEL; DAVID LIITTSCHWAGER

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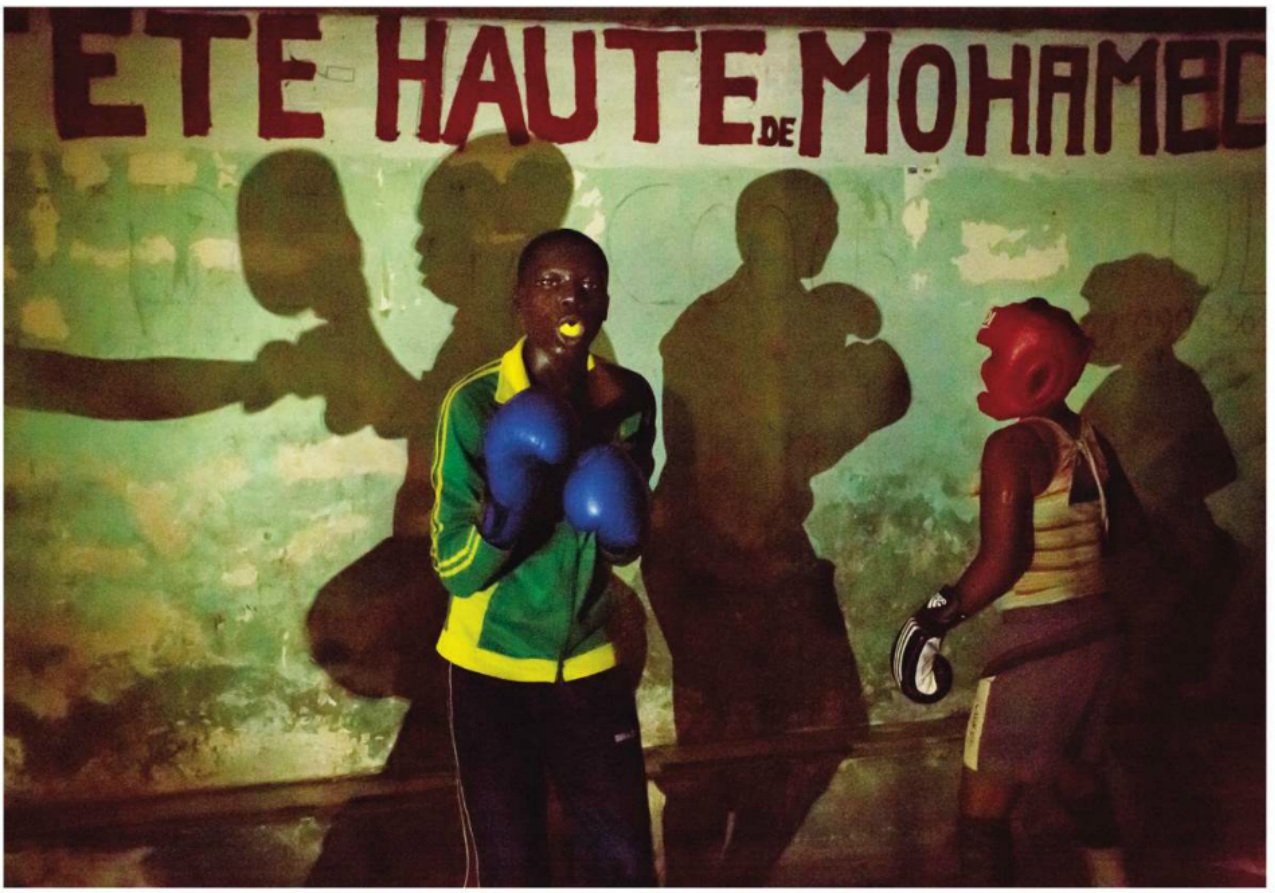
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Rumble in the Gym

In Kinshasa a woman punched photojournalist Pascal Maitre in the forehead. It was an accident—he got too close to some young women who were boxing. Everyone laughed, a light moment during a tense assignment in the Democratic Republic of the Congo. Kinshasa is rife with crime and poverty, but its people eagerly pursue the arts and athletics. This boxing club has ties to past glory too: The women train in the now dilapidated stadium where Muhammad Ali and George Foreman fought in 1974's "Rumble in the Jungle." *—Daniel Stone*



BEHIND THE LENS

Kinshasa can be dangerous. How did you protect yourself?

PM: The city is impressive and chaotic, but it's not more dangerous than most big cities. Of course, you have to be with people who know their way around and who can vouch for you. I made sure the police and information ministry knew what I was doing, so that they could help me stay safe. If you come back several times, they start to know you and give you enough space to work.

How did you get people to trust you?

It's difficult, but it can be very simple. You have to explain to people exactly what you want and what kind of story you want to tell. When people realize you know your topic, usually you find someone who wants to help.

Was it hard to take candid photos when your skin made you stand out?

During the three trips I made for the story, I never saw another white man in the street. I didn't face any discrimination, but a white man shooting pictures makes it hard to be discreet. Because of that, I couldn't stay somewhere too long, or people would start to wonder what I was doing. It required time and patience.

Breakthrough technology converts phone calls to captions.

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The Captioning Telephone converts phone conversations to easy-to-read captions for individuals with hearing loss

Do you get discouraged when you hear your telephone ring? Do you avoid using your phone because hearing difficulties make it hard to understand the person on the other end of the line? For many Americans the telephone conversation – once an important part of everyday life – has become a thing of the past. Because they can't understand what is said to them on the phone, they're often cut off from friends, family, doctors and caregivers. Now, thanks to innovative technology there is finally a better way.

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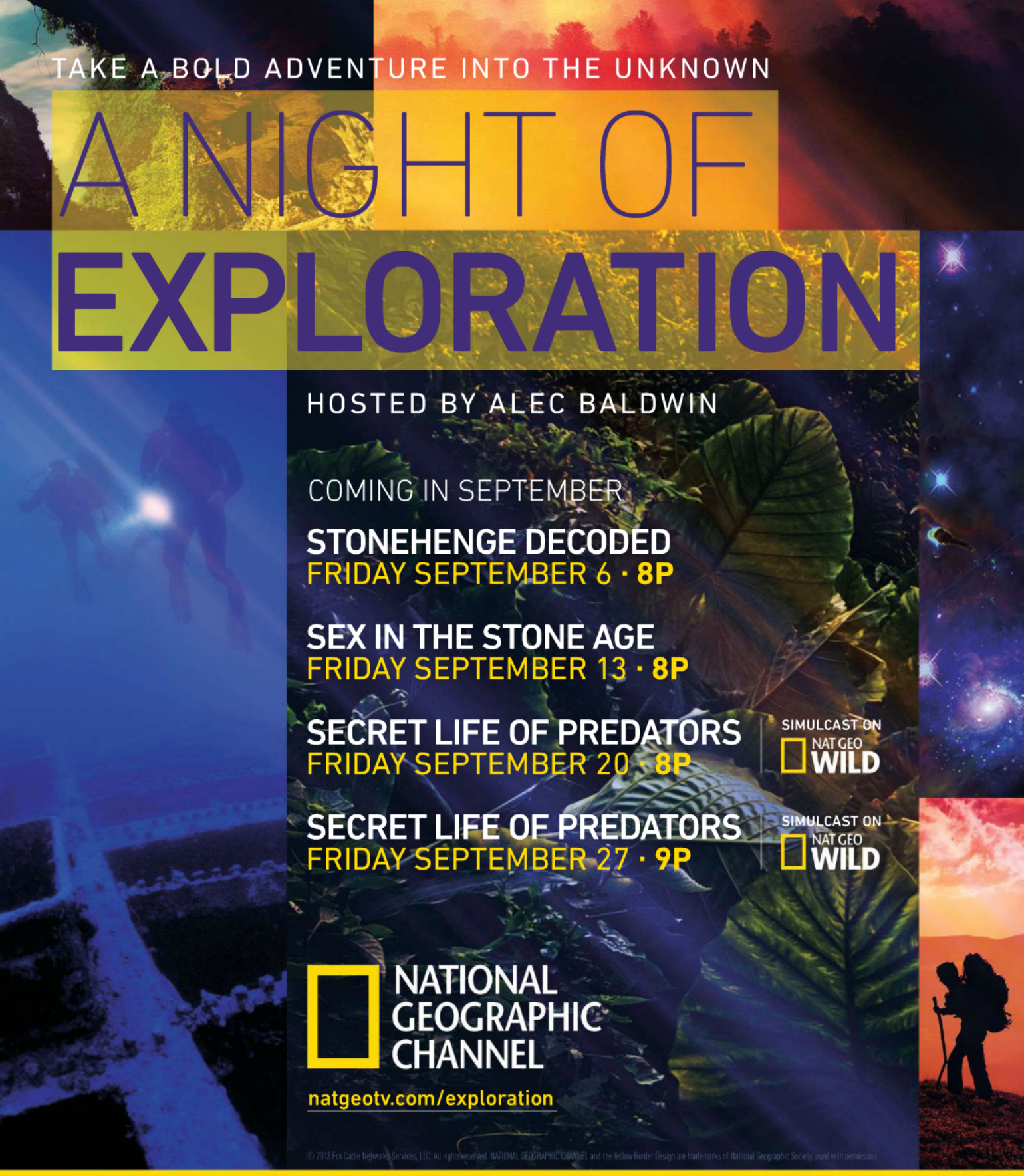


Old Wave The Belt Parkway seawall near Brooklyn's Fort Hamilton can't quite contain a wall of water from an October 1948 nor'easter. Surging storms have long plagued this stretch of the thoroughfare, which runs adjacent to New York Bay near the Verrazano-Narrows Bridge. When Hurricane Sandy slammed the region in October 2012, parts of the parkway were submerged for hours; water stood as deep as five feet in some places. The storm-ravaged seawall has since been repaired, but local residents still fear what the next big blow will bring. *—Margaret G. Zackowitz*

Flashback Archive Find all the photos at **ngm.com.**

PHOTO: *NEW YORK DAILY NEWS*, NATIONAL GEOGRAPHIC CREATIVE

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